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DEATH FROM ELECTRIC SHOCK.

In another column we print a letter from a correspondent at Demerara describing the circumstances of a death from an electric shock, received from a 52-volt alternating circuit. The lack of insulation found between the primary and secondary could not have had anything to do with the case, as if the secondary had been subjected to the voltage of the primary, even for a short instant, the fuses would have instantaneously been blown, and, unless very momentary, the lamps burned out and the conductors perhaps melted. The death might have been caused simply from the effect of the shock due to the 52 volts of the secondary circuit, either from the victim suffering from some predisposing organic trouble, or, if an ignorant man, from the fright of the sudden shock alone. Or the cause might have been that described by Dr. Hopkinson some years ago in a paper in *The Philosophical Magazine*, entitled "An Unnoticed Danger in Certain Apparatus for the Distribution of Electricity." It is here stated that danger exists in a certain electrostatic action, and if a transformer has a large electrostatic capacity a shock may be received that will certainly kill regardless of the voltage of the secondary. In Europe, we believe, it is customary to make provision for this through an earth connection. In a case calculated by Dr. Hopkinson, the electrostatic capacity is assumed at 0.3 microfarads, which figure, he states, may be attained in a transformer; it is then shown that under certain conditions an E.M.F. sufficient to send 0.3 of an ampere through the human body for a sensible time may be attained, which amount would certainly kill a man. The case cited by our correspondent would have been an excellent one to have applied the D'Arsonval-Goelet method of resuscitation to, and the chances are very good that the victim of the shock could have been revived At any rate, it further emphasizes the necessity to all those having to do with electricity of becoming acquainted with the method of resuscitation to be followed in case of shock. We have still left some of the sheets printed by us containing the necessary direction, which are at the disposition of our readers.

THE BROOKLYN STREET RAILWAY STRIKE.

As we go to press the threatened strike of the employes of the Brooklyn surface railways has just been inaugurated, affecting almost fifty street railway lines, mostly electrical, some six thousand employes and several hundred thousand citizens. The real point at issue seems to be the system of payment for those men who are employed only during the busy hours, or as extras. The men claim that if they have to remain at the companies' call during the entire day they should receive some extra compensation beyond that derived from the few trips they actually make, or that extra compenation should be allowed for the trips during the busy hours in order that their pay may more nearly approach what it would be if the same number of cars were run continuously. The companies, on the other hand, refuse to entertain the demands made for the reason that it would result in an additional expense which the income of their roads does not warrant. At the present writing it appears as if the strike would go against the employes, whose position is not upheld by the State Arbitration Commissioners, and whose places are being eagerly sought by other men. A feature of the strike that will doubtless be watched with much interest is in regard to the attitude that will be assumed by the United States Government with respect to the complication introduced through the running of mail cars, as the strikers do not seem inclined to accord the immunity claimed by the roads from the presence of these cars. The extreme and widely extended discomfort produced will also probably renew the question brought up by the Chicago strike last year, as to the rights of the public and their remedy against such a paralyzation of

their means of transportation. (A good purpose will be accomplished if the prominence given to the financial question will, through the claim of the companies as to their restricted funds for operating expenses, direct attention to the disposition of the earnings. The Brooklyn companies have been among the worst sinners in respect to watering stock, and in the case of the largest company it is asserted that but 15 per cent. of the capitalization represents real values. Electric traction has suffered severely everywhere from this cause, and it is well to bear in mind in the present instance in connection with the pleas of insufficient earnings, that the legitimate profits of passenger traffic have been enormously increased by electric traction, but subverted to pay the charges resulting from an inexcusably inflated capitalization.

CENTRAL STATIONS IN GREAT BRITAIN.

Two of our English contemporaries have recently issued lists of the central electric lighting stations of Great Britain, from which we learn that there are now 95 of these in operation, with 20 more in course of construction. In this country there are now more than 2,700 central stations in operation, and although the ratio between the two numbers does not give a correct idea of the relative electric lighting done in the two countries on account of the large size of almost all of the British stations, yet after making all allowances for this, the United States is still vastly in advance; indeed, it is probable that almost any one of our leading States can make a better showing. On the other hand, with few exceptions the British stations have been designed and constructed on true engineering principles, and but few stations in this country will compare favorably on this basis with them. Of the 86 stations now in operation of which information is given, 38 use the continuous current, and 6 of the 13 now in progress of which data are printed, will also generate continuous currents. Of the latter three will employ the three-wire method of distribution, and four the same in conjunction with storage batteries; one will use high tension currents with a secondary distribution from transformers, and another will generate current at 2,000 volts, which will be lowered by means of continuous current transformers in sub-stations and distributed by the two-wire system. All seven of the alternating stations will distribute from transformer sub-stations. Only one station will employ both continuous and alternating currents—that at Edinburgh. We have brought out these details of the stations of latest design to show how widely, in general, British practice departs from our own. Distribution from sub-stations, both with continuous and alternating current, is the method adopted for the majority of the stations, and E. P. S., not the Continental central station type of storage battery, is that which will be employed. The generating machinery in only 7 of the 13 stations will be direct-connected, rope-driving being employed in the others. For the night supply of current the price to be charged will vary from 12 to 16 cents per kilowatt-hour, the average being 13 cents; for the day supply the price ranges from 7 to 14 cents, the average being 9 cents per kilowatt-hour. When we learn the price of gas in Great Britain, the reason of the little advance made in electric lighting in that country appears clear. For example, in 13 towns where stations are now being installed, the price of gas ranges from 43 to 92 cents per thousand, the average being 68 cents. In a town where it is proposed to charge 16 cents per kilowatt-hour for electrical energy, the price of gas is only 62 cents per thousand; or, on the basis of 60 watts of electrical energy generated per lamp and 5 feet of gas per 16-candle-power jet, electric lighting will cost more than three times as much as gas lighting.

TROLLEY RETURN AND UNDERGROUND PIPES.

In another column we give a synopsis of the report by Mr. John A. Barrett to the Brooklyn Subway Commissioners on the corrosion of underground pipes by trolley return currents, which is of particular interest from confirming strongly the conclusions recently put forth by other authorities in regard to the subject. As will be seen, the numerous tests of Mr. Barrett showed that the corrosion was, as a rule, confined to well determined areas, whose limits may almost be determined *a priori*; that while the effects are serious in their nature the remedy is not a matter of conjecture, and its application is merely a question of cost for the necessary return conductors in the danger territory. It is shown that in Brooklyn the conditions are somewhat complicated by the distribution of power houses and the conductive action of bodies of water, and it is well that these factors have been brought forward, as they render the general problem of prevention of corrosion more definite. The principles upon which the problem rests are simple enough and is purely one of the consideration of relative conductivities. The return current will seek the path of least conductivity, but it does not necessarily follow that if underground piping forms part of this path the result must be injurious. The corrosive action occurs through the passage of the current into an electrolyte, which, in this case, is the moisture of the soil, but if suitable metallic connections are made by means of which it instead may ultimately leave the pipes, a harmful effect is avoided. This points to the necessity of having conductors led from the power house throughout the danger territory, there to be connected at intervals to the underground pipes. Of course, in order that the danger territory may be as restricted as possible and the difference of potential kept down, the railway return conductors should be given an ample capacity. While this is a general statement, each case will involve special conditions, and require a special solution, and this is well shown in Mr. Barrett's report in respect to the influence of the Brooklyn water front and the Gowanus Canal, and would apply also where a road passes over ground of varying conductivity, as when portions of the route is over a damp stratum of soil, or when the power house is situated on ground having a path of good conductivity to distant portions of the road. While, therefore, it would always be advisable when building an electric system to install at the beginning the conductors referred to throughout the territory adjacent to the power house, and to study the effect that will result from the neighborhood of bodies of water and take the necessary precautions at that time, in most cases there will still remain a portion of the problem to be studied after the road is completed. It fortunately happens that these later steps are quite simple, and merely necessitate a survey along the line of the road with a voltmeter, and as a rule the indications thus recorded will point directly to a remedy that mostly will be local in character, if the ones determined *a priori* as above have been previously properly applied.

Harmonic Call Bells.

Maj. H. Bagnold, R. E., in the London *Electrical Review* of October 20, refers to an article that appeared in The Electrical World of September 22, 1894, by Mr. S. D. Mott relative to harmonic call bells, and states that the principle there described is fully set forth in his British patent specification, No. 860 of 1891.

This patent is still maintained, he says, and a considerable number of "bell repeaters" constructed on this principle, as described in the London *Electrical Review* of November, 1891 (No. 728), have been sold during the last three years. Maj. Bagnold remarks that it is perhaps worth while pointing out that Mr. Mott's bell as designed would not ring. It would only make an unpleasant noise, and to make it ring one of the pole pieces must be removed. This seems to show that a bell does not vibrate in two ellipses, the major axes of which are at right angles one to the other, as stated by the late Prof. Tyndall.

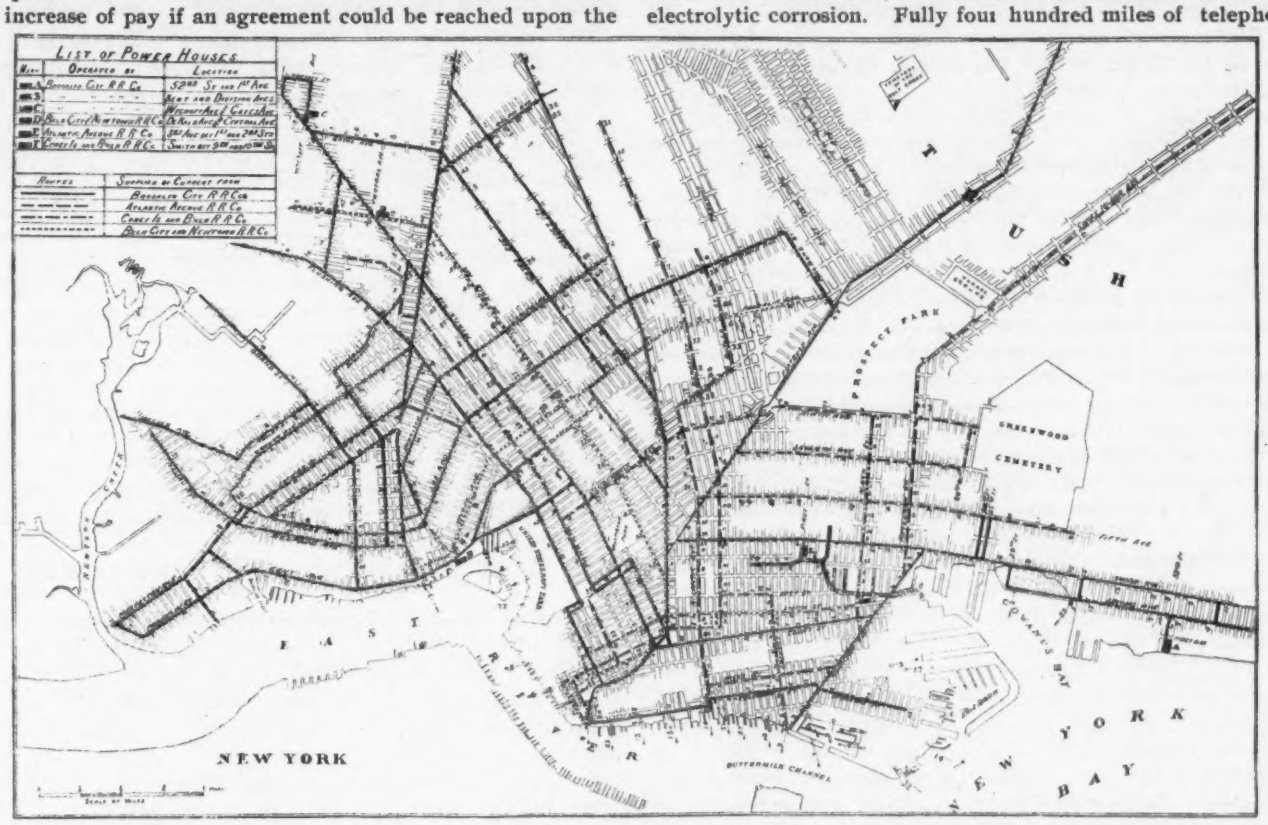
Mr. Mott, in a letter to the same journal replies to Maj. Bagnold, and says that the device referred to was described in The Electrical World, not as a fully completed invention, but as a suggestion for theoretical consideration, as he had not the experimental facilities to give such apparatus the scientific investigation on which to base a commercial form. Mr. Mott says it was invented by him in 1886, and a sample bell was made in 1891 by The E. S. Greeley & Co., of New York. The statement "to make it ring one of the pole pieces must be removed," he says is probably correct.

Mr. Mott adds that he was not aware that the device had been patented in England or elsewhere by Maj. Bagnold in 1891, nor that a considerable number had been sold during the last three years.

The Brooklyn Trolley Strike.

The greatest strike of electric street railway employees that has occurred since the commencement of electric traction was inaugurated on the morning of January 14, the strike affecting no less than 47 roads. Only two electric roads in Brooklyn are unaffected, the Jay and Smith street lines, and the West End and Coney Island line. Several hundred miles of road are idle, and fully 6,000 men are on strike. Up to the time of going to press no violence has been reported, but it is said that a plot has been discovered to disable power house machinery.

The strike is the result of the refusal of the street railway companies to accede to the demands of the men, which were three in number: first, an increase of pay from $2 to $2.25 per day; second, part remuneration for the time spent by men waiting for trips, and third, that employees making but a few trips per day during the busy hours be paid more than the proportionate rate for these trips, since, it was claimed, these trips have only netted the men about 25 cents apiece. It is understood that the men would not insist upon an increase of pay if an agreement could be reached upon the two last-named points. The companies have positively declined, with the exception of President Slocum, of the Jay street line, to entertain a single one of the demands, claiming that, in the present dull state of business, they could not afford to increase expenses.



MAP SHOWING TROLLEY ROADS OF BROOKLYN.

Electric Wires in Brooklyn.

In the report of the Brooklyn Board of Commissioners of Electrical Subways for the year 1894, a summary is given of the work of the Board to date.

The first electric wires laid in underground conduits under the direction of the first Board of Commissioners of Electrical Subways were drawn into the ducts in June, 1886. The work progressed during the summer, and plans were matured for a continuance of it in the spring of 1887. The Board of Alderman, however, passed a resolution on December 17, 1886, directing the Commissioner of City Works to refuse to grant permits for the purposes of constructing electrical subways. No progress was made by the Board during the summer of 1887. An appeal to the courts resulted in breaking the deadlock and work was resumed late in October of the same year. The existence of the Board terminated October 31, 1889, at which time 3,007 miles of conductors had been placed in the ducts and 768 miles carried upon the elevated railroads, making a total of 3,775 miles.

Since the beginning of subway work in 1886 there have been two interruptions to its progress, aggregating about three and one-half years of time. The total length of wire now in underground conduits is more than twice as great as the total of electrical conductors in the city when the first Board was organized.

The wires now on poles and house tops represent in amount only a portion of the growth of the electrical systems within the last few years. Fully sixty per cent. of all the wires within the limits of the city are now provided with spaces in conduits, or are carried by the elevated railroad structure.

It should be mentioned in this connection that a large amount of telephone wire buried in 1887-88 has been removed from the conduits, partly because of injuries incident to the locality and partly because the experience being new at that time the conditions incident to the situation had not been fully measured. Larger conduits were found necessary and gradually a double wire or "metallic circuit" for each subscriber was required to overcome new difficulties that came with the trolley.

Some loss was occasioned at first through a destructive action of one of the constituents of the creosoting compound upon the lead covering of the cables. This difficulty was met by substituting an alloy for the pure lead previously employed.

The latest and most potent cause of loss in the buried cables is the electrolytic corrosion. Fully four hundred miles of telephone wire have from various causes been thus rendered worthless. About three hundred miles have been rendered useless during the past year through the corrosion of the lead covering of the cables.

A notable event of the year just closing was the beginning of the construction of conduits from the high tension arc-light conductors. The Municipal Electric Light Company began the construction of its conduit early in the summer. The Citizens' Electric Illuminating Company began its underground work in September. An aggregate length of 112,000 feet or 21.2 miles of duct is prepared to receive conductors. Cables will be drawn in during favorable weather in the winter and the construction on conduits continued in the spring.

The District Telephone Companies employ only aerial lines, which are mostly supported on housetops. To insist on the burial of these wires would abolish the system. The expense of underground conductors would render its operation at present rates, or at any prices commensurate with the service afforded, impracticable, and the commissioners state that the public interests do not require the burial of these wires. The burglar alarms and the messenger boys cannot be dispensed with, and while citizens demand this simple and serviceable means of electrical communication the wires must remain in the air. Possibly, they state, with a more general use of the telephone, which is certain to come, the two distinct services may be performed by one system of underground conductors. Telephone lines are extended on poles in populous districts under other conditions. These are temporary structures only, and are permitted by this Board in locations where the telephone service is desired by the residents, and where the construction of an underground

conduit is not at present warranted by the amount of service called for.

The commissioners argue against a general inclusive subway designed to contain wires and pipes of all kinds except, perhaps, the sewers. Such a construction, they state, to be built in any of the city streets would require the removal of nearly all the present pipe and subway systems and their replacement in the new conduit. Moreover, the space called for by the proposed new scheme would be greater than the space now occupied, inasmuch as a transverse passageway is a part of the plan. On the other hand, for suburban districts destined to become populous and where the underground constructions are not yet begun, the general subway plan is an ideal one, and if it could be adopted would save much subsequent inconvenience. The ownership of such subway should obviously rest with the city.

As to corrosion of pipes from trolley currents, the Board reports that the areas within which injury can be done are clearly defined and that quite certain means of arresting the destruction have been found.

The aggregate length of electric conductors of all kinds within city limits (omitting areas added by last Legislature) is 15,914,688 miles. The length of conductors within new areas is 857.74 miles, or a total of 15,772.428 miles. The mileage of wires underground or on elevated roads is 9389.406.

The total length of aerial systems within the old city limits is 6447.532 miles. Wires buried during the year, including amount suspended as above stated, amount to 2005.43 miles.

A report by Electrician John A. Barrett on the subject of corrosion of underground pipes by trolley currents forms an appendix to the above. Mr. Barrett followed the plan of Mr. I. H. Farnham in mapping out safe and danger territory, taking voltmeter readings for this purpose of the potential difference between street car rails and 660 hydrants along somewhat over 100 miles of street. Since the positive poles of the power house generators are connected to line it was found, as expected, that in general the danger territory was in the vicinity of the power houses. Nevertheless, there are a number of variations from this rule, and the situation in this respect in Brooklyn is described as one of peculiar complexity.

Chief among these peculiar and complicating conditions is the operation of four principal and independent trolley railroads, with seven power stations in irregular and scattered positions, and with intricately crossing and interlacing lines of track. Lack of any common standard as to systems of feeders, supplementary wires, and returns adds to the confusion. The extensive water front of Brooklyn and the situation of two large power stations directly on the shore, and of two other power stations on Gowanus Canal, all with negative plates of considerable capacity sunk in the water, together with the discharge of a heavy amount of current from the cars between Wallabout and Gowanus, constitute an important special factor in the distribution of the earth currents. From the latter combination of circumstances there appears to be an almost continuous line of dangerous potentials upon the water pipes along the shore from the Navy Yard to Erie Basin.

The conditions about Gowanus Canal are also described as seriously compromising to the safety of water pipes in that neighborhood and the problem an intricate one, due to the relative situation of two power stations on the canal and three independent lines of road interlacing with each other in the immediate vicinity. In one case where the danger district was misplaced, the cause seemed to be indicated as due to a negative connection from the generators to a driven well near the canal, together with overloaded return wires from the rail system.

Regarding the question of corrective measurers, it is recommended that the first thing to be done is so far as practicable to keep the pipes clear of current in all those regions where there is a tendency of the current to overflow from the rails to the pipes. The one method by which this overflow may effectually be diminished is to provide a more liberal system of return conductors than at present prevails, at least on some portions of the Brooklyn railways. The limit to which the perfection of the return system should be pushed ought to be fixed only by considerations of reasonable cost.

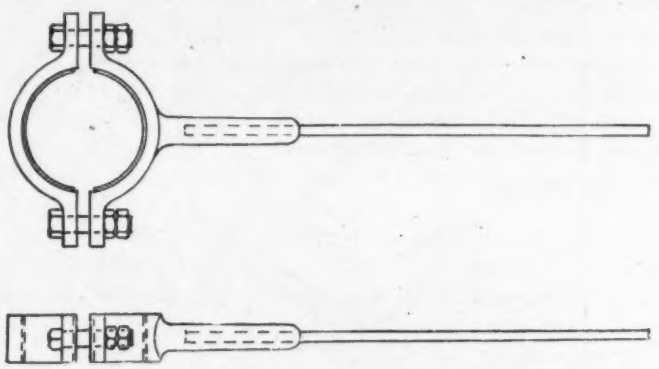
After everything that is reasonable has been done in this direction, there will still be a large overflow of current from the rails which will be collected by the pipes and will be conveyed along the pipe to points where the conditions favor its discharge again into the earth.

The second thing to be done is to locate, by careful investigation, the points where this large and unavoidable residue of earth current tends to leave the pipes; and, by a system of special return wires directly connected at brief intervals to the pipe mains, to draw off as much as possible of the accumulated electricity harmlessly from the pipes, and thus to obviate the electrolytic action which is sure to accompany the passage of the current directly from the surfaces of the pipes into the earth.

It is important to associate the two steps in their proper relations with each other. In general the attachment of special return wires to the pipes in the danger districts should not be undertaken until an adequate system of outlying returns has been provided by the railway companies.

After all that is practicable has been done to convey back the railroad current to the power stations by proper return conductors, then the pipes in the vicinity of power stations may be relieved of the unavoidable overflow by wires correctly applied. Under these conditions the railway companies will be prevented from relying upon the underground pipes—particularly the water pipes—as a material and proper part of their return systems, and the pipes, so far as regards the principal circulation of trolley currents, would virtually be safe.

The remedy for exceptional cases noted would consist chiefly in electrically uniting different lines of pipes at suitable points, in establishing metallic connections between pipes and rails at places indicated by the conditions, and, in general, in drawing the electrical current from the pipes by the direct attachment of negative feed wires at a point wherever a dangerous potential difference is found.



Clamp for Attaching Wire to Water Mains.

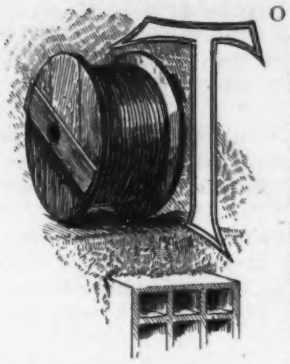
Several of the conclusions above outlined were tested in practice with the aid of the railway companies, and found in each case to be justified. The accompanying cut shows the form of clamp for making attachments to the water mains, made for the purpose under the direction of Mr. M. G. Starrett, chief electrician of the Brooklyn City Railway. The collar is of wrought iron in two parts, five-eighths of an inch thick, and two inches broad. The two parts are drawn together by ¾ inch bolts, with two nuts to each bolt. The collar is previously turned out upon its inner face to one-fourth of an inch larger than the diameter of the pipe to which it is to be applied. Midway in one part is formed a lug into which is brazed a No. 00 copper wire. In applying the connection the pipe is carefully brightened all around with a file. A strip of bright lead 5-32 of an inch thick and 2½ inches broad is laid around the pipe, and the collar is clamped down by the bolts until the lead gasket is meshed into the inequalities of the pipe. The lines of junction between the collar and lead and pipe are thickly painted over with "P. & B." mixture, then completely taped over, and again painted with "P. & B." upon the tape; after which the whole is thoroughly packed in with good cement. Mr. Barrett does not regard the thoroughness of this method as excessive in view of the requirements of the case.

One element in the problem of earth currents mentioned as of great importance is the relation between water and gas pipes. The independence and extent of the two systems of pipe are stated to undoubtedly produce situations where there is a strong localization of current through the earth from one to the other, and where that pipe is being continuously corroded from which the current is flowing.

The final conclusion of the report is that under the present condition in Brooklyn it appears indisputable that earth currents from trolley roads are causing extensive electrolysis of water pipes and other pipes and conductors imbedded in the ground, at an indeterminate but serious rate. It also apppears that there are practicable means at command which are being neglected, and which, if properly organized and applied, would largely abate, if not altogether arrest, the destruction now taking place.

The Making and Laying of Underground Cables.

BY WM. MAVER, JR.



TO attempt, in an article of limited length, to describe, in full detail, the various processes of manufacture and construction of all the different kinds of cables now employed for telegraph, telephone and electric light and power purposes, or of the many underground ducts or subways in which these cables are laid and which are now to be found in nearly all the larger cities of this country, would obviously be out of the question. I, therefore, must confine myself to a more or less brief account of the main processes of manufacture and construction of some of the more prominent types of cables and subways now in use.

The term electric cable, whether for underground or submarine use, may be taken to include the conductor, the insulating material and the armor or lead covering, as well as any jute or taping that may be added.

Practically without exception, the metal used for the conductors in all electric cables is copper, on account of its many advantages, such as flexibility, durability and high electrical conductance. The conductor may be composed of one solid wire of any desired diameter or it may be formed of a number of wires into a strand, but it is always of copper. The process of manufacture of the cable may, therefore, be taken up at the wire factory, where the copper is received in bars or ingots. The metal is first formed into rods, and is then prepared for drawing into wire of any desired size.

Wire Drawing.—This process is termed "wire drawing." It consists of pulling, or drawing, the rods or wires, while cold, through a steel die, in the manner indicated in Fig. 1, in which figure *R* is a reel on which wire has been wound, *I* is the steel die, and *D* is a pulling drum by which the rod or wire is drawn through the die. In this figure the wire is shown as having been reduced in size. In practice the copper rod is started through the die by filing the end for a short distance, when a clamp is attached to a chain and the latter to the drum *D*. *D* is in turn revolved by suitable machinery. Preparatory to "drawing" the rods and wire are coated with a flour paste which is then dried upon the metal by baking in an oven. In passing through the die the flour acts as a lubricant, and it is a curious fact that the copper wire is thereby prevented from coming into actual contact with the die, which, of course, is the main object of thus coating the wire.

When the wire has been reduced to the desired size, which may entail drawing it through several dies of diminishing diameter, it is then usually annealed to a required degree of "softness," or pliability, by heating. In practice the term "hard-drawn" is applied to copper wire to distinguish unannealed from the annealed or soft copper; the difference being that the "soft" wire is annealed after drawing, while the "hard-drawn" wire is not. For underground cables, hard-drawn, medium hard and soft wire are used, as may suit the desire of the purchaser. Hard-drawn wire is always used for overhead lines.

The question of purity of the copper is clearly an important one, as the slightest impurity in the metal has a very marked detrimental effect upon its electrical conductance. Experiments have shown that mere traces of arsenic in the copper will reduce its conductivity over 30 per cent., and even an impurity consisting of one or two per cent. of silver, which is at least as good a conductor as copper, will reduce the conductivity very appreciably, perhaps 8 or 10 per cent. It is, therefore, customary for purchasers of wire to specify a purity equal to 98 per cent. of that of pure copper; or, what is practically equivalent to that, they specify that the copper shall have a conductivity equal to 98 per cent. of pure copper, which insures the purchaser a practically pure metal.

The treatment during the processes of drawing and annealing the wire may also have a detrimental effect upon the conductance of the metal and may reduce its conductivity two or three per cent., depending somewhat upon the number of drawings through which the wire passes. In some factories, perhaps in the majority of them, chemical tests are made of samples of the copper before drawing to determine its purity, and, after drawing, electrical tests are also made. I am not sure that all purchasers of wire are equally careful, but it is well known that the large telegraph and telephone companies habitually test the copper wire received by them for use on their overhead lines. As a matter of fact, however, it may be remarked that the art of refining the copper and of manufacturing the wire has now reached such a state of excellence that it is an unusual thing to detect by the electrical tests any marked deficiency in the conductivity. Still, the writer has within a comparatively recent period tested samples of copper wire, concerning the purity of which there was a question, and found a conductivity of not over 85 per cent. of pure copper. As a little reflection will show that a 10 or 15 per cent. loss of conductance in a circuit might be a serious matter, the wisdom of making such tests becomes evident. The electrical tests for conductivity are usually made by the Wheatstone bridge method, employing a highly sensitive reflecting galvanometer.

Wire Tinning.—Wires intended for use in underground cables are frequently tinned, avowedly to prevent the sulphur contained in some of the insulating compounds from acting upon the copper, for which sulphur has a marked chemical affinity. The actual necessity for this coating of tin is sometimes questioned. It is true that the untinned metal is quickly blackened by such compounds, but apparently no further action occurs under normal conditions. The method of tinning wires is shown in Fig. 2. The wire is drawn from a reel *R*, into a vat *M*, containing a solution of muriatic acid

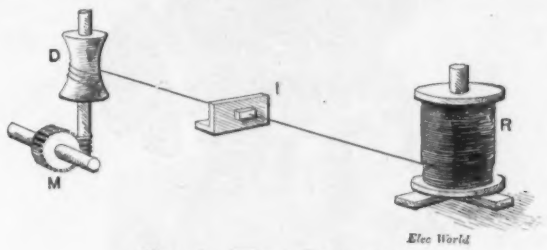


FIG. 1.—WIRE DRAWING.

and zinc, which thoroughly cleanses the surface of the wire, and from which it passes into and through a vat *T* of molten tin on to the reel *R'*. In leaving the vat *T* the wire passes between the folds of an asbestos mat *A*, which removes any superfluous tin that may adhere.

Wire Stranding.—The wire is now ready to be twisted with other wires into a strand, or, as a solid wire, to be covered with the insulating material. As a rule, the conductors of cables are solid up to a size of No. 2, B. & S gauge; above which size they are stranded; chiefly on the score of flexibility in handling. For the same reason many small cables are also stranded.

One method of stranding wires is shown in Fig. 3. The figure represents a stranding or cabling machine intended for stranding four wires. This particular machine is shown because of its simplicity for purposes of illustration. Machines are made for stranding 100 or more wires at one time. The single wires are placed on the spindles *S S*, from which they are led over the pulleys shown, up to a cap, or die, *C*, through which they pass to and through a guide *G*. Here the revolutions of the spindles twist the wires into the strand, which is seen passing over the "take up" drum *P*, and thence to the reel *T*. The machine, as a whole, is driven by the belt *B*, and the separate parts are, of course, appropriately geared

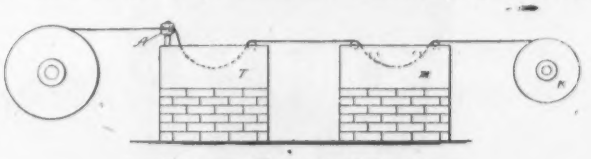


FIG. 2.—TINNING WIRE.

to maintain a definite relative speed and strain, one to the other. It will be understood that the spindles have an axial motion as well as a revolution around a common centre.

Insulating the Wire.—The conductor is now ready to be covered with its insulating material, the nature of which depends upon the type of cable, and also, to a considerable extent, upon the purpose for which the cable is intended. For instance, if it is to be a telephone cable, a thin paper insulation will most likely be required, owing to the low static capacity of "paper" cables, which is about .07 or .08 microfarad per mile. If the cable is intended for telegraph or electric light or power purposes, the dielectric may be paper or other fibrous material saturated with some resinous or bituminous compound, or it may be covered with some homogeneous material such as a rubber compound.

I may interpolate here that it is now common practice, in this country at least, to cover all underground cables with lead. In the case of fibrous insulating material this is necessary to exclude moisture, which would otherwise ruin the cable, and in the case of

rubber compounds the lead casing is essential to prevent the deterioration which would follow a free exposure to the air. The lead covering process will be subsequently described.

The conductors of paper cables intended for telephone purposes are wound very loosely with strips of soft paper, the strips being put on sometimes spirally and sometimes longitudinally; in the latter case the strips are held on by threads. The process by which the paper strips are put on spirally is practically similar to that described in the taping of rubber cables (Fig. 8). The con-

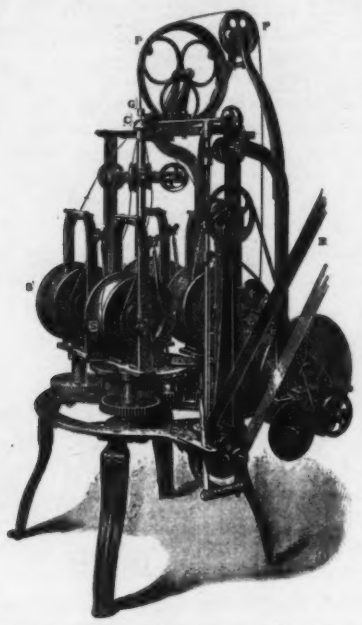


Fig. 3.—Wire Stranding Machine.

ductors thus covered are then twisted "in pairs," after which the pairs are built up into one large cable of twenty or fifty pairs, more or less, preparatory to being lead covered. I may say in passing that the object of putting the paper on loosely is to reduce the static capacity, which reduction, when thus obtained, is due to the fact that this looseness of the paper permits air to have access in numerous places between the conductor and the paper, while, at the same time, the paper effectually prevents the conductors from coming

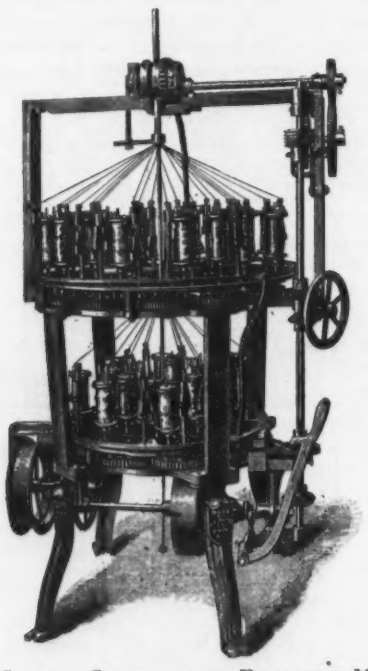


Fig. 4.—Cotton Covering or Braiding Machine.

together in metallic contact. It will be understood that any reduction of static capacity obtained in this way is due to the lower static inductive capacity of air as compared with any solid dielectric.

Another form of paper cable used on electric light circuits is made up of paper strips, which are put over the conductor solidly, in layers of any desired thickness. The whole is then immersed for several hours in a hot, resinous oil, after which it is encased with lead.

The proper thickness of the insulating wall of cables intended for high potential circuits is determined, not only by the electrical pressure standing qualities of the material, which quality varies with different materials, and which can only be determined, primarily, by experiment, but also by the mechanical strength which it may be considered necessary to impart to the material, to enable it to properly withstand the more or less hard usage it may be subjected to in winding on reels, hauling into and, possibly, out of, underground ducts, etc.

Another form of cable, commonly termed fibrous cable, which is used extensively for telegraph and electric light and power purposes, is made by winding cotton thread or jute in alternate layers over the conductor.

One means of covering conductors in the foregoing way is shown in Fig. 4. This particular machine covers the wire in two layers, the under layer having 16 threads, the upper layer having 24 threads. The bare conductor is shown passing up through the

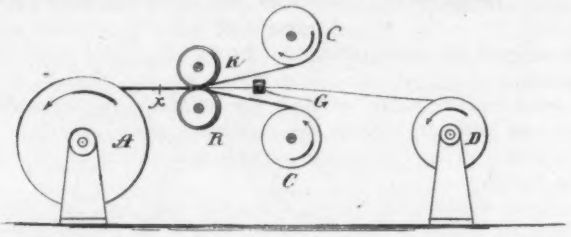


Fig. 5.—Rubber Strip Covering Apparatus—Lapping Process.

floor to the machine. The two sets of spindles holding the threads are shown one above the other. Usually the layers are put over the wire in opposite directions; consequently the upper and lower spindles revolve in opposite directions, and as they revolve, the spindles or bobbins move past each other with an in and out motion, thus forming a braid over the wire. The number of layers and the thickness of the cotton or jute threads depend upon the use for which the cable is intended. When the conductor has been covered to the desired thickness, it is then, as in the case of the paper cable just described, placed in a vat where it is boiled in an insulating compound for several hours, or until all traces of moisture have been driven from the fibrous material, when it also is taken to the lead covering machine. This is assuming a single conductor cable, otherwise the several insulated conductors would be built up into cable form as previously described.

The next type of cable which may be considered is one in which the insulating material is a rubber compound, much of which is used on electric light and power circuits and also for telegraph pur

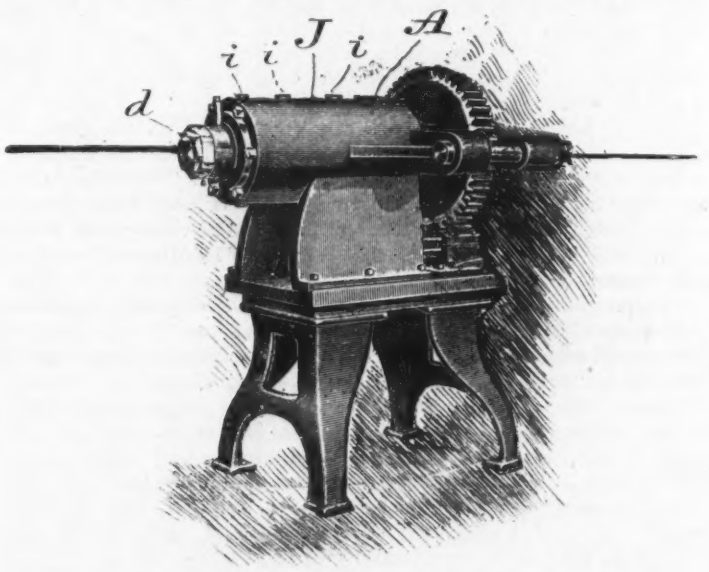


Fig 6.—Rubber Compound Covering Machine—Seamless Process.

poses. In this type of cable, as in that of some already described, the ingredients of the insulating compound and the manner in which it is prepared are usually trade secrets, known only to the manufacturers and a few trusted employes. The basic ingredient, however, of all high grade rubber compound cables should be pure rubber. The manner in which the prepared compound is put over the conductor varies with different makers. With some makers the compound is calendered into a sheet of any required thickness, which is then cut into long strips. These strips are then placed

over the conductor by a process which is shown diagramatically in Fig. 5. The rubber strips are placed on the reels *CC*, and are then led between grooved rollers *RR*, which are provided with sharp cutting edges. The wire is rolled off from the drum *D* and passes through the guide *G*, to the rollers *RR*, where the rubber strips are pressed closely around it, the pressure causing the respective strips to adhere to each other, and at the same time the surplus rubber is removed by the cutting edges of the rollers. The width and thickness of the strips, of course, depend upon the size of the wire and the purpose for which it is intended. In practice, espe-

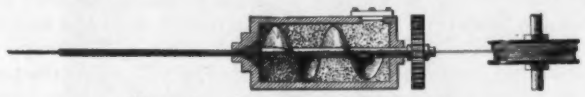


FIG. 7.—COVERING MACHINE.

cially with the larger sizes of wire, it is usual to place a tape over the insulation before the compound is vulcanized to the required degree of hardness, in which case a taping machine is generally placed at a point *x* between the rollers and the "take up" reel *A*.

In other types of rubber cables but one strip of rubber is used, and in others again the compound, while in a plastic state, is placed over the conductor while passing through a suitable die. This latter process, which produces what is termed a "seamless" cable, is shown in Fig. 6. The rubber compound is fed by an attendant into a chamber through an aperture *A*. The material is kept at a proper working temperature by a jacket *J*, over the chamber; steam or hot or cool water, as may be necessary, being admitted to the jacket at the points *iii*. By a suitable worm screw device, outlined in Fig. 7, the compound is forced in requisite quantities towards the die *d*, which is the point at which the compound is placed around the

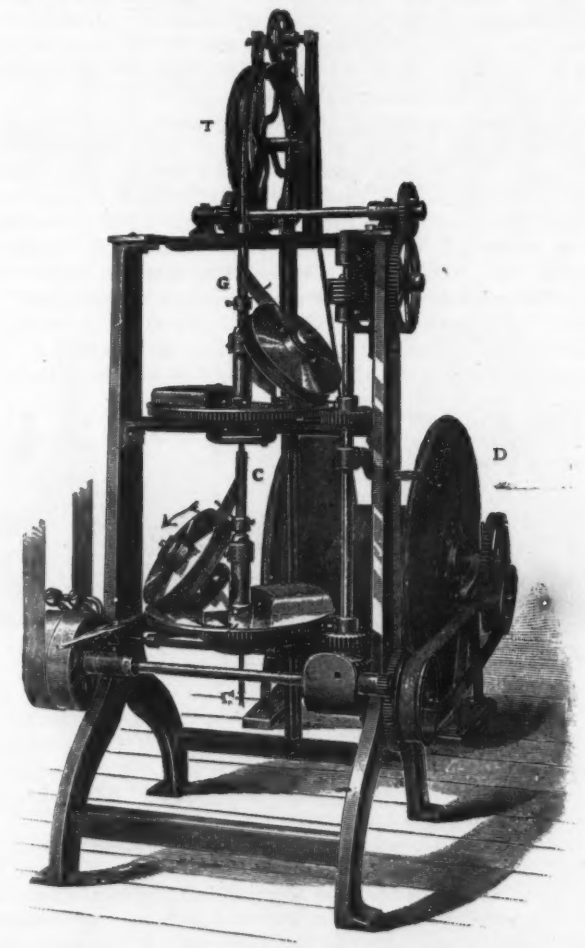


FIG. 8.—TAPING MACHINE.

wire. The wire passes from a reel, through the chamber, as indicated in Figs. 6, 7, and in passing out it is held rigidly and accurately in the centre of the die *d*, by which means the compound is distributed evenly over the conductor. After leaving the machine the newly covered wire is drawn slowly along a table on which is placed quantities of powdered talc, or soapstone, to a reel on which it is taken to the vulcanizing chamber, unless a tape is first to be placed over the insulating material, which is usually the case excepting for the smaller sizes of wires. It is found that the taping assists in preventing flattening of the comparatively soft compound, prior to and during vulcanizing; more especially in the case of very heavy conductors.

Taping Machine.—A taping machine is shown in Fig. 8. This is a double, or two reel vertical taping machine. For the case in point a horizontal machine could be employed. The insulated wire is shown as coming up through the flooring to the guides *CG*, in

FIG. 9.—MEASURING MACHINE.

each of which there is a slot through which the tape passes to and around the conductor. The platforms carrying the reels holding the tape revolve in opposite directions, as indicated by the arrows. The taped conductor then passes several times around a take-up drum *T*, and thence to the reel *D*.

Vulcanizing.—The vulcanizing process consists of placing the rubber covered cable in a large iron chamber which is main-

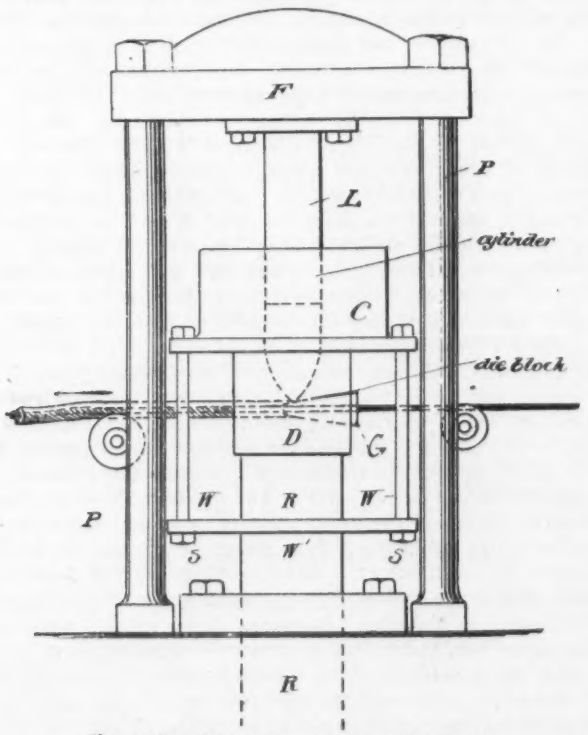


FIG. 10.—LEAD COVERING MACHINE.

tained at a temperature of from 300° to 400° F. Considerable care is required in this process, and the most favorable temperature and the length of time required to bring the compound to the desired degree of hardness and tenacity are matters of experiment, and vary with different compounds. It is well known that sulphur is the chief ingredient which undergoes the chemical combination with the rubber to bring about the marked change in the consistency and color of the compound which occurs during exposure to the high temperatures mentioned. As

may be well known, the compound usually enters the vulcanizing chamber a soft, yellowish compound and comes out a dark blue tenacious substance. This particular color, however, may be varied by the introduction of other ingredients, without injury to the insulating qualities of the compound. One or more differently colored insulated wires are frequently used in telegraph and telephone cables as "markers" to assist in tracing the wires.

In the case of rubber compound cables the next proceeding is to place them in large tanks filled with water, where they are allowed to remain a longer or shorter time to admit moisture to the conductors should any imperfections exist in the insulating material. To ascertain whether any such imperfections exist careful electrical tests are made, usually by the "direct deflection-method," in which the Thomson or D'Arsonval reflecting galvanometer is used. In case any defects are disclosed by the tests the next proceeding is to localize

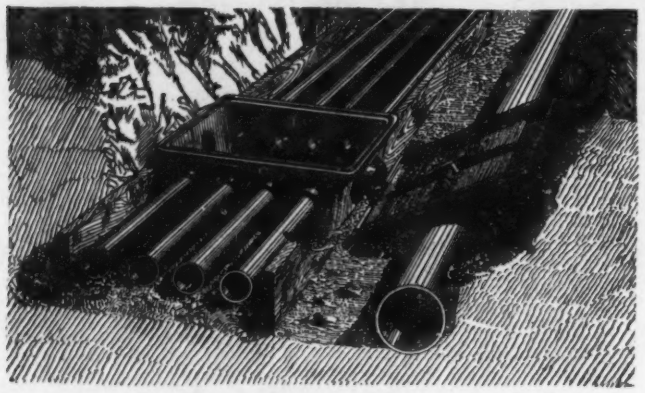


Fig. 11.—Wrought-Iron Distributing Ducts—Showing Hand-boxes and Ventilating Pipe.

and remove them. Descriptions of such tests are to be found in various text books.

Measuring Machine.—There is an important little machine used constantly in the process of braiding, taping and insulating wires, which I should not omit to mention. It is a device for measuring and recording the length of wire passing through the various machines. Its operation will be readily understood from an examination of Fig. 9. The wire *W* is caused to pass between the wheels as shown, in doing which it causes them to rotate. It is then evident that at every revolution of, say, the larger wheel, a definite length of wire will have passed, and as this wheel is appropriately geared by clockwork with the hands of the dials, the total length of wire or cable passing through is recorded and may be read at a glance. In the figures the lower dial indicates in 100 feet, the upper in 1000 feet, units. The machine is adjustable as to height. As each reel is filled the attendant marks the amount of wire, on suitable tags, whereupon the machine is reset to zero.

Lead Covering.—With the completion of the foregoing processes and tests, fibrous and rubber cables are now ready to undergo lead covering, the operation of which is highly interesting. In Fig. 10 a vertical type of lead covering machine, in which the lead is put on hot, is shown. *F P F* is the iron framework of the machine, which framework, as well as the other parts of the machine, is of massive construction, to withstand the great pressure necessary to properly place the lead over the insulation. The pillars *P P* are of solid iron, about 10 inches in diameter. The following are the parts of the machine: *R R* is the hydraulic ram, which is also of solid iron, and about 15 inches in diameter. It passes down into a vault in the ground several feet, the hydraulic pressure being applied at the lower end. *D* is the die block, *C* is a hollow cylinder into which the lead is placed; *L* is termed the lead ram, or plunger. It is also of solid iron, 5 inches in diameter, and is rigidly bolted to the framework *F*. Its lower end fits snugly into the receptacle in the cylinder *C*, as indicated by the dotted lines. Inasmuch as the die block must be changed to suit the size of cable to be covered, a frame *W W W'* is provided to permit of its easy removal. A ring or flange *W'* is attached to the ram *R*, as shown. The die block *D* rests on the top of *R* and the cylinder *C* rests on *D*, in which respective positions they are held rigidly together by screw bolts *s s*.

It will be seen by the dotted lines that there is an opening in the die block immediately under the opening in *C*, and that this opening tapers nearly to a point where it reaches the cone-shaped guide *G*, through which the cable passes, as shown.

The manner of preparing the lead and the machine for the operation of lead covering the insulation is practically as follows:

The hydraulic ram is dropped down, and as it carries the die block and the cylinder with it, the lead ram or plunger, *L*, is withdrawn from the cylinder. The cylinder is then filled with molten lead, alloyed with three or four per cent. of tin, which operation is termed "charging" the machine. As it is obviously not desirable to attempt to place the lead in a melted state over the insulation, the charge is allowed to chill somewhat before the operation of covering is proceeded with. The time necessary to allow the lead to reach the desired temperature, or, so to speak, the desired plastic condition, is found by experiment. It varies with the size of the cable and may range from three to four minutes. The temperature of the lead may range from 300° to nearly 600° F., when the process is begun. To prevent undue chilling of the lead, gas jets, not shown in the figure, are placed around the cylinder. At the proper time pressure is slowly applied to the ram *R*. The pressure exerted on the end of this ram in some cases amounts to 500 tons. The pressure causes the cylinder to rise up against the plunger with the result that the lead within the cylinder is pressed down into the die, forming a circular envelope, or tube, around the cable. At the same time, by suitable "take-up" drums, or reels, the cable is drawn through the die block, as outlined in the figure.

The die block and the cone-shaped guide may be so adjusted that any desired thickness of lead envelope may be placed over the cable, and also so that it will inclose the insulation, loosely or snugly, as may be desired.

The lead for this purpose was originally alloyed with tin in about the proportions stated, with the design of preventing the effects of gases or acids upon the lead, numerous instances having been found where the lead was converted into a porous and friable carbonate of lead, in creosoted wooden ducts, and it was supposed that this alloy would render the covering immune from such attacks. However this may be, it is also found that the tin adds a certain rigidity to the lead which is useful in drawing the cables into and sometimes out of the underground ducts.

Almost without exception the underground electric light and power cables in this country are made with but a single conductor in one cable. A notable exception is the well-known "Edison" three-wire tube conduit or cable, which consists of a pipe or tube, generally of iron, containing the wires, and into which tube a melted insulating material, which subsequently hardens, is forced. To hold the wires in place should the insulating material soften, a jute rope or other suitable material is wound spirally around them.

Laying Underground Cables.—The final process at the factory after lead covering is the electrical testing of the cable, whether of fibrous or homogeneous material, to insure that no defects exist in the insula-

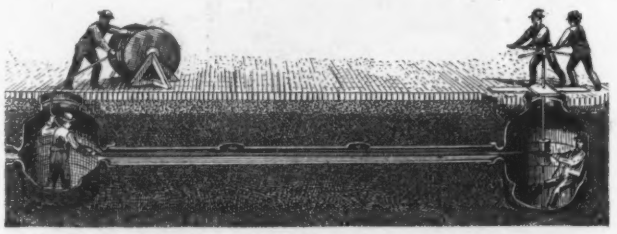


Fig. 12.—Hauling Cables into Subway Ducts.

tion or conductor. In the case of multiple cables, such as are used for telegraph and telephone purposes, the conductors are tested also for crosses and open circuits.

The completed cable is then placed on reels and forwarded to the vicinity of the underground duct in which it is to be laid.

The type of underground conduit now being most generally introduced in this country is that known as the "drawing in and out" system. By "drawing in and out" is meant a system in which a substantial duct or ducts are provided, with manholes at regular intervals, and into which ducts cables can be drawn and, if necessary, drawn out, at will. This term is used to distinguish such conduits from those in which the cable or conductor is placed directly in the ground, or in a duct, which is solidly filled with an insulating material which is then placed in the ground and from which the wires or cables cannot be removed without again digging up the streets. The remarks which follow will treat only of the former type.

Drawing in conduits may consist of one or more ducts, as best suits requirements, of from two to four inches in diameter. The ducts may be of wrought iron, earthenware, cement lined with thin sheets of iron, of each of which there is a considerable amount now in actual use. Wooden ducts are also used. The tubes are usually laid

in a bed of concrete. The iron pipes are joined together by a screw coupling, the earthenware and cement pipes by a cement joint. The manholes are placed from 200 to 300 feet apart. They average about 7 feet in depth by 5 feet in width.

The general method of laying these ducts in the streets of large

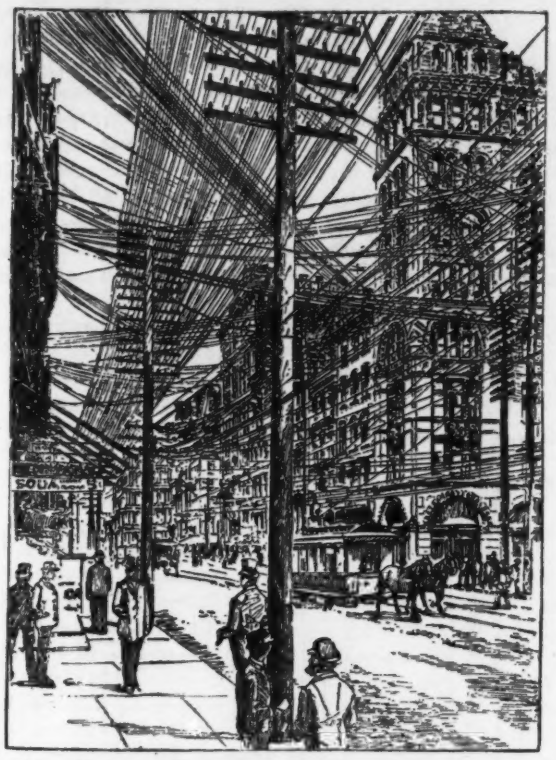


FIG. 13.—VIEW OF CITY STREET WITH OVERHEAD WIRES.

cities is shown in Fig. 11, which represents a few lengths of wrought iron tubing, with also a ventilating pipe shown at the right of the figure. The ducts shown in this figure are termed "distributing" ducts, in contradistinction to "trunk" ducts. The distributing ducts are placed as near the surface of the street as possible and are provided with openings termed hand-boxes, about 2 feet square, which

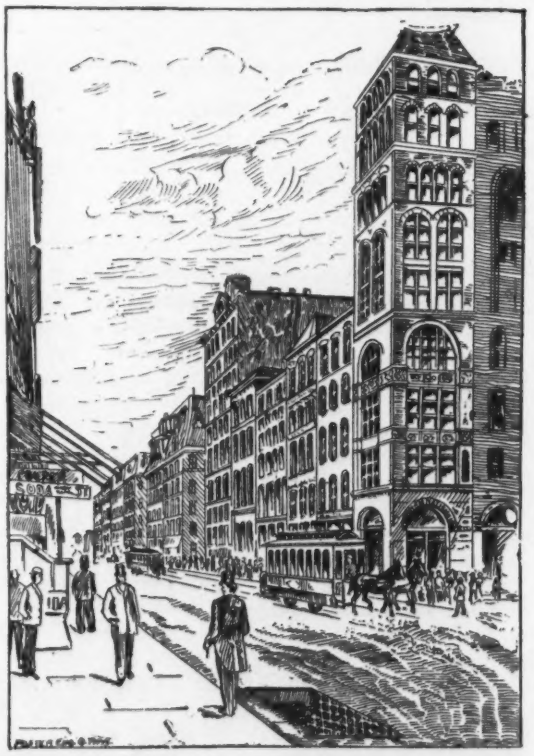


FIG. 14.—VIEW OF CITY STREET WITHOUT OVERHEAD WIRES.

give access to the cables for the purpose of making side connections into buildings. The trunk ducts are placed below the distributing ducts, and access to the cables contained in them can only be had at the manholes.

The ventilating pipe is used to force air into the ducts and manholes of the subways, to drive out any gas that may leak into them from adjacent gas mains. These air pipes have small openings made in them by which the air enters the manholes, and they are fed by "blowers" at stated points along the route of the subways. This system of ventilation has not only been found effective in freeing the subways from gas, thereby preventing explosions, but also in measurably tending to keep out dampness from the ducts and manholes.

The specific means by which the cables are drawn into the ducts depends somewhat upon the size and weight of the cable. If a light cable, it may be drawn through the duct from one manhole to another, by means of a rope in the hands of two or three men. If a heavy cable, it will require a windlass or capstan, to provide sufficient hauling power. In Fig. 12 the general method of thus hauling cables into the ducts is represented. It is clear that some means must be provided to get the rope through the duct prior to pulling the cable through. This is now usually done by the plan termed "rodding" the duct. This simply consists of employing a sufficient number of rods, each three or four feet in length, provided with suitable screws at each end. The process begins by pushing one rod into a duct, then another rod is screwed on to the first one, which is then pushed along the duct, when another rod is attached, and so on, until the first rod reaches the distant manhole, at which time a rope is attached to the last rod. The proceeding is then reversed, the rods being drawn out of the duct and unscrewed one after another, until the rope is reached, when the rope is attached to the cable and the arrangements for hauling it into the duct are begun.

An idea of the different aspect of a business street in any of our larger cities before and subsequent to the placing of the wires underground may be gathered from the illustrations, Figs. 13 and 14, which represent a portion of Broadway, down town, New York, prior to and after the overhead wires in that and other main thoroughfares of that city had been placed in the subways.

Surprise is sometimes expressed by the uninitiated that the large mass of overhead wires which formerly existed on such avenues as Broadway, New York, could be disposed of in such a comparatively small number of ducts in the underground subways. The explanation is, however, apparent when it is considered that all the conductors formerly existing on a one hundred wire telegraph or telephone pole line can readily be stowed away into one cable in a three-inch duct in the subways.

A Premature Announcement.

A correspondent sends to us the following interesting item clipped from a Nebraska paper dated July 26, 1879, and which originally appeared in the New York correspondence of the Philadelphia *Ledger*:

"I am informed, on authority almost as reliable as that of Mr. Edison himself, that the inventor, after spending so much valuable time and means on the elaboration of his theory of electric light, has dropped it, or has determined to do so, and has determined to adopt that of Mr. Wallace, of Ansonia, Connecticut, who has already constructed a machine for producing the light, and advanced somewhat in the line of solving the great problem of the division of the same. It is called the 'carbon' theory, while Mr. Edison has held to the platinum theory, whatever these terms may imply. At any rate, the announcement, some time ago, by the New York papers, that Mr. Edison had solved his great problem, was a trifle premature."

The Reporter and a Short Circuit.

Recently the end of a broken section of the trolley wire of a Cleveland railway fell to the ground and a local reporter describes the result as follows: "The entire width of the street was apparently covered by a sheet of blue flame, extending 30 feet into the air above the ground. The approaching motor retreated from the point of contact between the wire and the track and the display ceased. The motor again approached the spot and the flame again shot into the air. Each display was accompanied by a series of explosions similar to a volley of musketry."

The Hatchet Planimeter.

Those interested in this simple little instrument, which has been described and referred to a number of times in our columns, will find a complete mathematical discussion of it by Mr. Poulain in "Cosmos," Dec. 15.

Electrical Power Transmission.—IX.

BY LOUIS BELL, PH. D.

Power Transmission by Continuous Currents.

There are at the present time three companies operating constant current circuits in San Francisco for the distribution of power. The currents employed are of 10, 15 and 20 amperes. Most of the motors are small, a very large proportion of them being under one horse power. The total number of motors in circuit on the various systems is between six and seven hundred. One of the companies is now gradually shifting its motor load on to a 220 volt circuit and abandoning the series distribution; another is planning for a 500 volt power circuit, constant potential, to replace its existing system; while the third, which operates by far the largest number of motors on a 10 ampere circuit, still adheres firmly to its original method.

Except in San Francisco, what few constant current motors are in operation are nearly all on regular arc circuits. Their use is, as a rule, discouraged by the operating companies, and very few new motors are being manufactured or sold; in fact, constant current distribution in modern American practice is almost non-existent and probably will soon pass entirely out of use. Abroad, the conditions are somewhat different, and on the Continent constant current distribution for long distance transmission work has been exploited to a very considerable extent, probably owing to the early and successful establishment of a number of transmission plants for single motors worked on the series system. There are several successful plants operated at constant current, the most considerable of them being that at Genoa, which is by far the best example of the kind and as such is worth more than a passing mention, even although the probability is that it will never be duplicated elsewhere.

It is somewhat singular, indeed, that in Italy, the home of Ferraris, who has done so much in the development of a rational and efficient system of transmission by alternating currents, the first notable transmission plant should have been installed with continuous currents.

The Genoa transmission is derived from the River Gorzente, which about fifteen years ago was developed for hydraulic purposes, artificial lakes being established and a tunnel about 1¼ miles long being built for outlet. Beyond the tunnel, an aqueduct some fifteen miles in length conveyed the water to Genoa, where a considerable amount of power is utilized directly. In this development there was left at the mouth of the tunnel an unused fall of nearly 1,200 feet aside from the head employed in the aqueduct. This has been developed electrically. It was divided into three partial falls of 338, 357 and 488 feet, respectively. At each of these was erected a generating station with its own transmission line. These stations were named after the three renowned electricians, Galvani, Volta and Pacinotti. The first mentioned station was the first installed. It consists of two generators operated in series. Each is of about 50 kw capacity, giving 47 amperes with a maximum pressure of 1,100 volts. Current is kept constant by regulating by hand the speed of the dynamos through the gate which controls the turbine. Each dynamo is provided with an automatic switch short circuiting the machine in case of extreme rise in voltage. This Galvani station was a preliminary or experimental station and was followed up by the establishment of two others which supplied the power to Genoa. One of these stations, which is thoroughly typical of the system employed, is shown in Fig. 23. It consists of four turbines, each driving a pair of dynamos of a little less than 50 kw output at 45 amperes and about 1,000 volts. These dynamos are closely similar to those

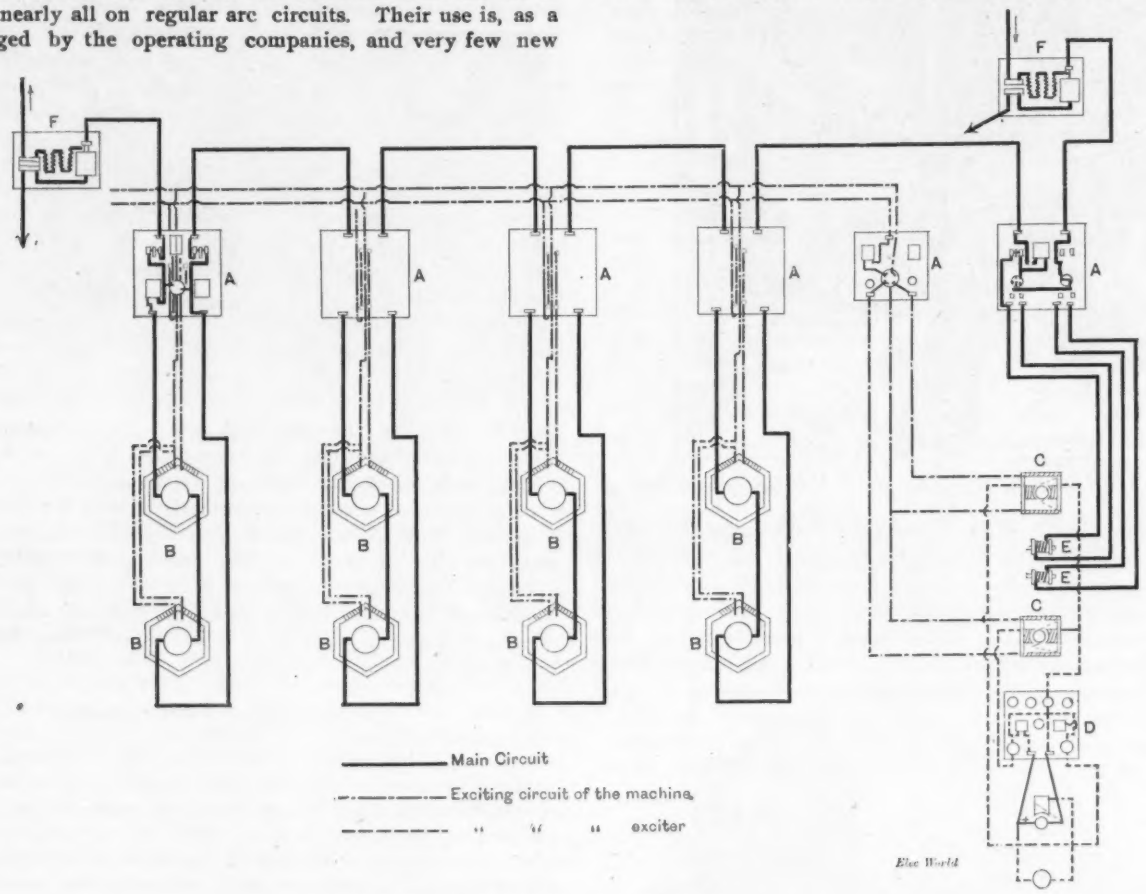


Fig. 23.—Plan of Volta Station.

in the Galvani station, but the regulation for constant current is obtained in a different manner. The dynamos are separately excited, the fields being supplied in parallel from a small dynamo driven by a separate waterwheel. The speed of this exciter is automatically varied by controlling its turbine in response to changes of current in the circuit. All the dynamos are operated in series and like those in the Galvani station direct coupled in pairs. The machines are insulated with enormous care, heavy layers of mica being placed between the magnets and the bed plates, while the windings themselves are very elaborately protected. Carbon brushes are employed, and the commutators are reported to behave admirably. Each dynamo is protected by the same elaborate safety devices employed in the Galvani station. The regulation is said to be excellent, even under considerable changes of load.

The third station, Pacinotti, contains eight machines of the same capacity as those in the preceding. They are governed as in the Galvani station by controlling their speed. This, however, is done by an electrical motor-governor controlled by a relay on the main line and working in one direction or the other as the occasion may require. In all the stations are carried out the same elaborate precautions regarding insulation, and each machine has around it an insulated wall supported on porcelain. The line voltage from each of the two stations last mentioned is from six to eight thousand and two circuits are carried into Genoa, the extreme distance of transmission being about eighteen miles. The conductors are for the most part bare, except when passing through villages, and are supported on oil insulators carried by wooden poles, save in some few

cases where iron poles have been used. The two circuits running into Genoa transmit power for motors only. As might well be imagined, incandescent lighting would involve some very troublesome transformations.

At full load, nearly 1,000 hp is transmitted over the lines, the motors being of all sizes between 3 and 60 horse power. They are of the ordinary series wound type, and their speed is automatically controlled by centrifugal governors, which act by varying the field strength. They are provided with carbon brushes, and are reported to operate very successfully. It is to be noted, however, that the motors are usually placed in special rooms with insulated floors and walls owing to the enormous voltage which has to be taken into the buildings. They are fitted with heavy fly-wheels to assist the governors, and with automatic switches to short-circuit around the motor in case of excessive voltage. The motors are under the special care of skilled assistants connected with the staff of the generating station who inspect the lines and go over the motors at intervals of a few days. These extraordinary precautions both in the matter of insulation and skilled attendance account in great measure for the success of what, under American conditions, would have almost infallibly resulted in disastrous failure. The efficiency of the plant from turbine shaft to motor pulley is said to be a little over 70 per cent. As may be judged from this description, the whole installation is of an enormously complicated character, and the most remarkable thing about it is not so much that it works passably well, as that it works at all. The plan of the Volta station for the most part explains itself. The switchboards for each machine with their plugs for connecting the pair of dynamos connected to it are shown at *A*, dynamos at *B*, the exciters at *C*, exciter switchboard and rheostat at *D* and the solenoids, which control the exciter turbines, at *E*. Lightning arresters are shown at *F*. These consist of a spark gap, impedance coils in series with the line and condenser shunted around them. Every motor is provided with a similar lightning arrester. Taken all together, this Genoa plant is an excellent example of the constant current system followed to its legitimate conclusion. A description of the system is a sufficiently condemnatory criticism judged from our present point of view; at the same time, it should be remembered that several years ago, while this station was being built, the method adopted was practically the only one available in the existing state of the art, and the operation of such a system for several years with even tolerable results speaks volumes for the thoroughness with which the installation was made, and the intelligent supervision that it has had.

(To be Continued.)

Practical Notes on Dynamo Calculation.—XXIII.

BY ALFRED E. WIENER.

Chapter 41.—*Forms of Field Magnets*—(Continued).

The combination of two horseshoes with common pole pieces furnishes two further forms of field magnet frames. Fig. 81 shows the *horizontal double horseshoe type*, and Fig. 82 the *vertical double horseshoe type*.

Machines of the former type (Fig. 81) are built by the United States Electrical Co. (Weston), New York; the Brush Electrical Co., Cleveland, O.; the Ford-Washburn Storelectric Co., Cleveland, O.; the Western Electric Co., Chicago, Ill.; the Fontaine Crossing and Electric Co. ("Fuller"), Detroit, Mich.; by Crompton & Co., London, Eng.; by Lawrence, Paris & Scott, Eng.; and by Schuckert & Co., Nuremberg, Germany.

The latter form (Fig. 82) is employed in dynamos of Fort Wayne Electric Corporation ("Wood"), Fort Wayne, Ind.; La Roche Electric Works. Philadelphia; Granite State Electric Co., Concord, N. H.; Electric Construction Corporation (Elwell-Parker); and Crompton Co., London, England.

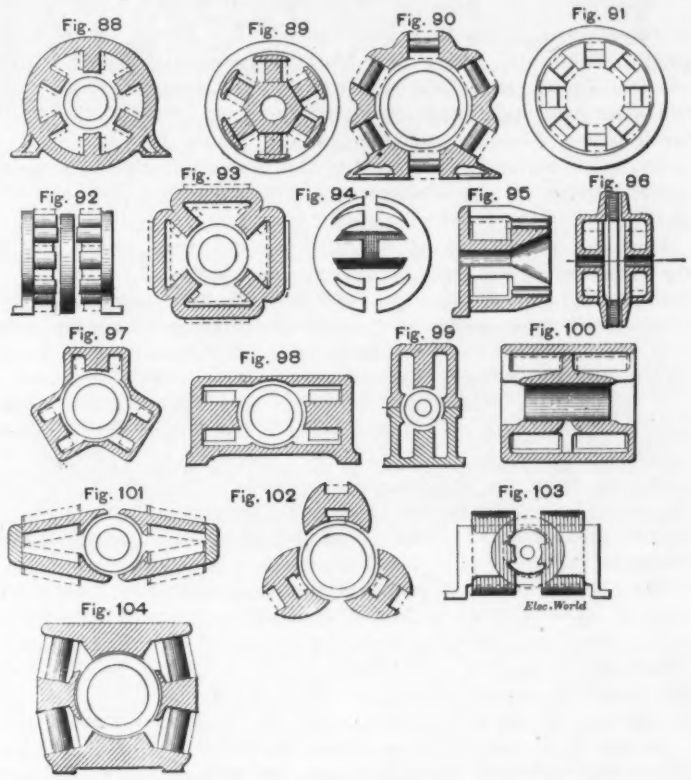
If one or both the pole pieces of a consequent pole double magnet type are prolonged in the axial direction, that is, toward the armature, and the winding is transferred from the cores to these elongated pole pieces, then a type is obtained in which the magnet frame forms a closed iron wrappage with inwardly protruding poles. Forms of this feature are known as *iron clad types*, and according to the number of magnets and to their position are single magnet and double magnet, horizontal and vertical iron clad types.

Fig. 83 shows the *horizontal iron clad type*, having two horizontal magnets. It is used by the General Electric Co. ("Thomson-Houston Arc Light type"), Detroit Electric Works, Detroit, Mich.; Eickemeyer Co., Yonkers, N. Y.; Fein & Co., Stuttgart; and Aachen Electrical Works (Lahmeyer), Aachen, Germany.

A modification of this type consists in letting the poles project parallel to the shaft, one above and one below, or one on each side of the armature; the only magnetizing coil required in this case will completely surround the armature. This special horizontal iron clad form, which is illustrated in Fig. 84, is realized in the Lundell machine, built by the Interior Conduit and Insulation Co., New York.

In Figs. 85 and 86 the two possible cases of the *vertical single magnet iron clad type* are depicted, the magnet being placed *above* the armature in the former and *below* the armature in the latter case. The *single magnet iron clad overtype*, Fig. 85, is adopted in the machines of the Muncie Electrical Works, Muncie, Ind., and in the battery fan motor of the Edison Manufacturing Co., New York. Machines of the *single magnet iron clad undertype*, Fig. 86, are built by the Brush Electrical Engineering Co., ("Mordey"), London; and by Stafford & Eaves, England.

The *vertical double magnet iron clad type*, Fig. 87, having two



FIGS. 88 TO 104.—TYPES OF MULTIPOLAR FIELDS.

vertically projecting magnets, one above and one below the armature, is employed in machines of the Wenstrom Elec. Co., Baltimore; the Triumph Elec. Co., Cincinnati, O.; the Shawhan-Thresher Elect. Co., Dayton, O.; the Card Motor Co., Cincinnati, O.; the Johnson Electric Service Co., Milwaukee, Wis.; the Erie Machinery Supply Co., Erie, Pa.; and the Zurich Telephone Co., Zurich, Switzerland.

There are various other bipolar types, which, however, mostly are out of date, and therefore of very little practical importance. These can easily be regarded as special cases of the types enumerated above.

b.—Multipolar Types.

Multipolar—Field magnet frames can have one or two magnets for every pole, or each magnet can independenly supply two poles, or one single magnet, or two magnets may be provided with pole pieces of such shape as to form the desired number of poles of opposite polarity.

If the number of magnets is identical with the number of poles, the magnets may either be placed in a *radial*, a *tangential*, or an *axial* position with reference to the armature, and in the two first named cases they may be put either *outside* or *inside* of the armature.

The *Radial Outerpole Type* is shown in Fig. 88; this form has been adopted as the standard type for large dynamos of the General Electric Company, Schenectady, N. Y.; of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; the Crocker-Wheeler Electric Company, Ampere, N. J.; the Riker Electric Motor Company, Brooklyn; the Stanley Electric Manufacturing Company, Pittsfield, Mass.; the Fort Wayne Electric Company,

Fort Wayne, Ind.; the Eddy Electric Manufacturing Company, Windsor, Conn.; the Belknap Motor Company, Portland, Me.; the Shawhan & Thresher Electric Company, Dayton, O.; the Great Western Electric Company (Bain), Chicago; the Walker Manufacturing Company, Cleveland, O.; the Mather Electric Company, Manchester, Conn.; the Claus Electric Company, New York; the Commercial Electrical Company, Indianapolis; the Allgemeine Electric Company (Dobrowolsky), Berlin, Germany; the Oerlikon Machine Works, Zurich, Switzerland; Alioth & Co., Basel, Switzerland; the Berlin Electric Construction Company (Schwartzkopf), Berlin, Germany, and numerous others.

In Fig. 89 is represented the *Radial Innerpole Type*, which is used by the Siemens & Halske Electric Company, Chicago, Ill., and Berlin, Germany; by the Alsacian Electric Construction Company, Belfort, Alsace; by Naglo Bros., Berlin, Germany; by Fein & Co., Stuttgart, Germany, and by Ganz & Co., Budapest, Austria.

The *Tangential Outerpole Type*, Fig. 90, is employed by the Riker Electric Motor Co., Brooklyn; by the Baxter Motor Company, Baltimore, Md.; the Mather Electric Company, Manchester, Conn.; the Dahl Electric Motor Company, New York; the Electrochemical and Specialty Company, New York ("Atlantic" Fan Motor), and by Cuenod, Sauter & Co. (Thury), Geneva, Switzerland; generators of this type are further used in the power station of the General Electric Company, Schenectady, N. Y., and in the Hustal, Belgium, Arsenal.

Machines of the *Tangential Innerpole Type*, Fig. 91, are built by the Helios Electric Company, Cologne, Germany.

In the *Axial Multipolar Type*, Fig. 92, there are usually two magnets for each pole, one on each side of the armature, in order to produce a symmetrical magnetic field. This form is used by the Short Electric Railway Company, Cleveland, O.; Schuckert & Co., Nuremberg, Germany; Fritsche & Pischon, Berlin, Germany; Brush Electric Engineering Co., London, England ("Victoria" Dynamo), and by M. E. Desroziers, Paris, France.

Fig. 93 shows the *Raditangent Multipolar Type*, which is a combination of the Radial and Tangential Outerpole Types, Figs. 88 and 90, respectively, and which is employed by the Standard Electric Company, Chicago, Ill.

If only one magnet is used in multipolar fields, the pole pieces may be so shaped as to face the armature in an *axial* or in a *radial* direction. In the former case the *Axial Pole Single Magnet Multipolar Type*, Fig. 94, is obtained, which is used by the Brush Electrical Engineering Company (Mordey), London, England, and by the Fort Wayne Electric Company (Wood), Fort Wayne, Ind.

In the latter case the Outer-Inner Pole Single Magnet Type, Fig. 95, results, in which the pole pieces may either *all* be opposite the *outer* or the *inner* armature surface, or *alternately outside* and *inside* of the armature; the latter arrangement, which is the most usual, is illustrated in Fig. 95 and is employed by the Waddell-Entz Company, Bridgeport, Conn., and by the Esslinger Works, Wurtemberg, Germany

(To be continued.)

Accidents to Fly Wheels in Power Houses.

To the Editor of The Electrical World:

Sir:—Referring to the discussion of fly wheels in the columns of The Electrical World, I think that in most of the accidents the cause is centrifugal force together with bad design and poor workmanship.

It does not appear that these disasters are confined to electrical generating stations, or, considering the great liability of engines racing in dynamo driving, that they are remarkably frequent.

With the exception of very poor material or design, it does not appear possible that the spokes should be fractured. In an ordinary wheel the spokes are of great strength in comparison to the strain upon them at full load. The only shock they can receive is through the inertia of the parts between the rim when the latter is suddenly checked. Considering that the large wheels generally drive a number of independent units, and taking into account the flexibility and slipping of belts, it is apparent that the shock on the spokes will be slight. When the "instantaneous effort to increase the speed" occurs, or why it should produce any extra strain on the spokes when the load is thrown off by the circuit breaker, is beyond my comprehension.

I fear that the adoption of Mr. Stuart-Smith's theory, that centrifugal force can produce no direct tension in the rim, would lead to disastrous results. I will simply suggest that fitting the spokes loosely in the rim (as mentioned by Prof. Sharp) would produce a rim that could only be fractured by shearing, and that the theory would also apply to the shell of a boiler, where the pressure also acts radially outward. While the direct tension, which is undoubtedly produced in the rim, is generally small compared to the tensile strength of the iron, it may approach the strength of the joints in a sectional wheel.

The bending moment in the rim may be an important factor, but owing to the continuity of the rim over the spokes and to the spokes being rigidly attached to the rim the case is far from the common theory of beams. I should be pleased to hear of a better method of determining it.

It is to be regretted that we have not the complete data of any of the wrecked wheels, but I think a wheel carefully designed and of such proportions as to avoid as far as possible initial strains in the iron is, if well constructed, as safe as any piece of engineering work.

A. M. Phillip.

Copper Fuses.

To the Editor of The Electrical World:

Sir:—Mr. Preece in a paper read before the Royal Society of London, April 19, 1888, states that the relation between the diameter D of a copper wire and the current C required to fuse it may be expressed by the law $C=ad^{3/2}$ where a equals 10,244 when d is expressed in inches and C in amperes. With this constant he calculated a table of diameters of copper wires which will be fused by different currents between 1 and 300 amperes. Mr. Preece does not claim to have proved the law for currents as large as 300 amperes. In fact, in a previous paper of December 22, 1887, the largest current used, according to the data given, was less than 60 amperes.

I do not know whether any one has accurately determined the relation between fusing current and diameter for currents as large as 300 amperes. If any of your readers have any authentic data on the subject, I should like to know of it. It is my opinion that the law will not hold for as high values as those given in the computed table which you published in your issue of December 15. I believe that as the current increases the value of a will decrease. It will be noticed that in the table of results obtained from samples of copper wire 6 inches long, given by Mr. Preece in the paper of December 22, 1887, that a diminishes as the current increases between one and 53 amperes.

I recently observed the current required to fuse a large copper wire freely suspended in the air. It was a No. 6 B. & S. wire, and fused at 390 amperes. It did not fuse immediately, but carried the current for nearly a minute before it began to melt. This wire has more than twice as large a sectional area as that given in Mr. Oxley's table for a 390 ampere fuse. I have further data which tends to prove that the value of a is smaller for large currents.

For a given diameter and short lengths of wire the fusing current, of course, depends on the length. It seems highly important, therefore, that the electrical engineer should experimentally determine the fusing current for large copper fuses rather than depend upon a table computed from data obtained from very small wires.

B. S. Lamphear.

Ithaca, N. Y.

Death from Electric Shock.

To the Editor of The Electrical World:

Sir:—A death occurred here the other day from shock, under rather peculiar circumstances, and I should be glad to learn if any of your readers know of a similar case occurring elsewhere.

An ordinary 16-cp 52-volt lamp was suspended in the stable of a house, and upon a black man going to turn it on he received a shock, from which he did not recover. He was in his bare feet at the time and the ground was damp. The house circuit was a 52-volt alternating, secondary with 1,040 primary. All the lamps continued to burn as usual after the accident, and no fuses were blown. On testing the transformer the next day I found a slight leakage between the primary and secondary, the insulation having no doubt broken down completely when the current was on. The insulation of the feeders and mains was the same as usual the afternoon of the accident and also the next morning, there being no extra ground on. On testing the house circuit the next day I found a slight ground on the stable circuit, but this should have been in favor of reducing the shock that the man got off the same circuit.

Arthur H. Shaw.

Georgetown, Demerara, Dec. 29, 1894.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamo.—A new and somewhat odd form designed by Messrs. Fritsche & Pischon is described and illustrated in the "Elek. Anz.," Dec. 16. The armatured iron is laminate lengthwise, not perpendicularly, to the shaft as usual; these iron bars can be used at the same time as conductors or the copper conductors may be threaded into holes through them; the armature is in the form of a ring resembling a Gramme ring in appearance, but not in construction, and the field magnet poles of opposite polarity are on the outside and inside of the ring; in a three-pole machine, for instance, all the south poles are on the outside and all the north poles are on the inside; it is claimed that by this system the construction of the armature is greatly simplified; the winding appears to be similar to that in the well-known machines of these inventors.

Constructing Small Dynamos.—The Lond. "Elec. Rev.," Dec. 21, begins a series of articles in which it will give the details of a small machine of simple construction which was designed specially for that journal by a practical engineer; it will be equally applicable as a continuous current dynamo of 100 volts and 8 amperes, as a motor of the same input giving about ¾ hp, as an alternator of 70 volts and 8 amperes and a frequency of 30, as a two-phase alternator, a converter of continuous and alternating currents, or the reverse, and as a converter of multiphase into continuous currents; the article does not admit of being abstracted; the present installment is introductory.

Transformer Pits.—Some further discussions and conclusions regarding this subject are contained in the Lond. "Elec. Rev." and "Elec.," Dec. 28; the former contains also an editorial discussion.

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Production of Rotary Magnetic Fields by a Single Alternating Current.—The recent Institute paper, by Mr. Gutmann, is reprinted in full in the "Elec. Rev.," Dec. 26 and Jan. 2, "West. El.," Dec. 29, and in abstract in a number of other electrical journals. He describes a method devised by himself some years ago, in which neither condensers nor choking coils are used. The single phase alternating current passes around what corresponds to the field magnets of the motor; the armature (in which currents are induced) contains closed circuit windings, but these circuits do not coincide in number with the poles of the field magnet; he shows that the tendency of such a closed circuit coil is to place itself midway between the two poles of the field, both poles being on the outside of the armature; such an armature will run either at the full, synchronous speed, or at certain other fixed speeds which have a certain commensurable relation to the periods of the exciting current, which speeds he calls harmonic speeds; this action is explained in detail with the aid of a large number of illustrations; polyphase currents are generated in the armature; the greater the number of closed circuits the greater is the number of harmonic or synchronous speeds at which the armature can run; the system embodies all the weak points of the synchronous and all the strong points of the polyphase motor; the motor will not start from a state of rest in the form shown; it has a small starting torque when rotated, and when in rotation it cannot be reversed by changing the connection; the strong points are that the motor develops polyphase currents, in its own winding, and that it is very difficult to pull it out of step, as it has the capacity to stand what he terms magnetic slippage; the motor "becomes self starting as a series, a shunt or an induction motor in a field of single phase or polyphase alternating currents," he illustrates this with a diagram in which the armature has a commutator to rectify the polyphase current to energize the field of one pair of a double system of magnets. "There is in this principle involved the germ of the ideal distribution of power."

Alternating Current Motor.—An illustration of a new form of motor made by Ganz & Co. (Budapest) is illustrated in the "Elec. Rev.," Jan. 29.

Electrical Machinist Practice.—In the serial, by Mr. Hobart, in the "Elec. Eng.," Jan. 2, he explains a practical method of testing an armature for a running balance; it consists in mounting it with flexible shaft couplings made of spiral springs, revolving it at the required speed while supported by temporary guides which can be loosened; the armature should be balanced, say, by adding solder to the binding wire, until it does not wobble when the guides or bearings are entirely removed. (Might it not facilitate matters if the armature shaft thus mounted were placed in a vertical instead of a horizontal position?)

Dynamo Design.—In the serial in the "Elec. Age.," Jan. 5, by Mr. Harrison, he discusses the magnet frames of dynamos, giving Kapp's formula and tables.

LIGHTS AND LIGHTING.

Luminous Power of Lighthouse Apparatus.—A paper by Mr. Bourdelles, read before the Maritime Congress in London, in 1893, is published, apparently in full, in "Lond. Engineering," Dec. 28. He discusses a theory of his own; only a short reference is made to electric lighting, and in this he says that as the intrinsic brightness of the arc is said to remain constant, no matter what the nature of the carbons, their distance apart, or the currents, it follows (according to his theory), that the illumination obtained by the apparatus ought itself to be invariable, and the luminous power of an apparatus of a given order would be independent of the electric burner that illuminates it; that is, the luminous range would be independent of the electric energy; but reliable photometric investigations contradict these conclusions, and prove with certainty that the illumination varies as if the intrinsic brightness was itself variable; notwithstanding this, however, he states that until this anomaly is explained, he considers that it is proved, at least in practice, that lighthouse apparatus using electricity makes no exception to the general rule.

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Projectors for Coast Defence.—An article on this subject, reprinted from an English journal, is published in the "Journal of the Military Service Institution," for January. It contains little of interest to electricians. The author discusses the use of projectors from the standpoint of a military engineer; he discusses the way in which projectors should be used, their best location, and similar features. He concludes that the most advantageous position for an observer with respect to a target illuminated by the projector is such that the line drawn from his position to the target makes an angle of from 30 to 60 degrees with the beam of the projector; he believes that a really efficient employment of projector can be obtained only by having them controllable at a distance.

Continuous Current from the Alternating Arc.—Mr. Feather, in the "Elec. Eng.." Jan. 2, describes the following experiment: by placing the end of an ordinary bar magnet near an alternating arc, he found that it repelled the arc in such a way as to make a flame on both sides of the carbon, and by placing an electrode in each of these two arcs, and connecting them through a tangent galvenometer, he obtained a unidirectional current, thus forming a novel sort of commutator for converting alternating into direct currents. Another method of obtaining the same result was described in the Digest Dec. 1 and 15, under the heading "Researches with the Electric Arc."

The Making of an Incandescent Lamp.—The "Elec. Eng.," Jan. 2, contains an article, including a large number of illustrations, describing the lamp factory of the General Electric Company, at Harrison, N. J. (Practically the same ground was covered, and in greater detail, in the article by Lieut. Eyre, in THE ELECTRICAL WORLD, Jan. 5.) Each lamp passes through 41 different hands; the bulbs are blown in molds, which insures absolute uniformity; the bamboo filament is now replaced by one made up of a very pure quality of cellulose, which is forced, when in liquid form, through a die of the required diameter, and is hardened by passing through alcohol; the filaments are treated by flashing; the heavy filaments are cemented to the platinum under naphtha, while an alternating current is passed through them; the filaments and stem are joined with a drop of liquid carbon cement; the Sprengel pump is used, and each lamp is individually connected to the pump; the quality of the vacuum is tested by touching one terminal with a spark coil having a half-inch gap, a glow indicating a poor vacuum; the lamps are sorted by running them to the required candle power, and marking the voltage

required. The present capacity is 28,000 lamps per day, requiring 500 hp and 900 employes.

POWER AND HEAT.

Utilization of Wind Power.—The article of Mr. Kennedy (see Digest last week) is concluded in the Lond. "Elec. Rev.," Dec. 28. He describes the Lewis system (see Digest Jan. 5), and adds that whatever device is adopted to adjust for varying speeds, there is a loss in using it, and a much larger mill must be installed to do the work in a system like this one, in which all winds corresponding to speeds of less than 750 or over 1,500 are lost while at only one speed, 1,200, is the dynamo doing its full duty; by using compressed air storage these regulations for varying speeds become unnecessary, and if the air cylinders are large enough for a three or four days' supply, no electrical accumulators would be necessary.

Elastic Couplings for Gas Engines.—The questions of the action of an electric coupling between a gas engine and a dynamo is discussed theoretically by Mr. Blondel and Mr. Guillaume, in "L'Ind. Elec.," Dec. 25. The former calls attention to the fact that in a preceding article by the latter he supposed the engine to have an infinite inertia; he makes a correction for the same, and concludes that an electric coupling should either have a very rapid period of oscillation or a very slow one, in proportion to the inequality of the coupling; the second is the easier method, except for alternators; he concludes that an elastic coupling is not only not bad, but, on the contrary, theory agrees with practice in showing that it is excellent under the condition that all proportions are properly chosen. Mr. Guillaume, in replying, states, among other things, that a system having rapid oscillations amounts to one which is practically rigid, while if a coupling is to be effective, the system should take care of a considerable retardation or advance.

Refuse Destruction.—A description, accompanied by large drawings, of a destructor made in Montreal, is published in "Ind. and Iron," Dec. 28.

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Irrigation by Electricity.—An article from the "Irrigation Age" is abstracted in the "Elec. Age," Jan. 2, and the "Elec. Rev.," Jan. 9. An estimate is given in which it is stated that 1,000 hp will run 56 motors of 15 hp, furnishing abundance of water for 15,680 acres, at a cost, not including ditches and reservoirs, of about $160,000, or a little over $10 per acre; assuming 3 pounds of coal per hp per hour, and one man for 10 motors, the total operating expenses would be $100 per day, or less than $1 per acre.

Peculiar Case of Engine Governing.—The "Elec. Eng.," Jan. 2, describes a case in which it appears that the dynamo in a direct driven plant magnetized the governor wheel on the end of the engine shaft, producing a very unsatisfactory regulation of the governor.

Thermal Storage.—In an article, accompanied by a number of illustrations, Mr. Perry, in the "West. El.," Jan. 5, describes the Halpin system, in which heated water and steam are stored in large reservoirs. (See Digest Feb. 11 and 18, 1893, under "Power Generators.")

Turbine Plant.—That of the Buchanen Power and Electric Company is illustrated and described in the "West. El.," Jan. 12.

TRACTION.

Traction.—The discussion of the recent Institution papers is concluded in the Lond. "Elec. Rev.," Dec. 28, abstracts of which are published in the "Elec." Mr. Ferranti believed that the hideousness of the overhead system had been greatly exaggerated, and that if the wires were in the way of fire escapes, he suggests that electricians should invent and give for nothing fire escapes which could be worked without interfering with the overhead lines. Mr. Sharp called attention to the flywheel as a means of storage of energy for electric traction; he suggests a safe limit of speed for the rims had not yet been reached; at 300 ft. per second, a flywheel of 10 tons, with a five per cent. variation of velocity, would give 190 hp minutes; with the present construction of flywheels, the safe limit seemed to be about 100 ft. per second; Americans run much closer to the limit, "and they unfortunately seemed to get a good many cases of flywheel accidents;" the solid disc flywheel was very much better than one made with 6 or 8 arms; he describes a flywheel invented by himself (illustrated in the "Elec."), in which the spokes are made of mild steel, arranged tangentially like the spokes of a bicycle wheel, the ends being fastened only to the rim. Mr. Dallas spoke in favor of the gearing now adopted in this country at the Thomson-Houston works; they had come to the conclusion that the losses were smaller with cast-iron gears than with any other form, the cast iron being close grained with a considerable quantity of wrought-iron scrap mixed with it; gearless motors were rarely of any use for street traction. Mr. Wilkinson, in reply, spoke very favorably of the conduit road in Washington. Dr. Preller replied at some length, chiefly in regard to steep grade roads; at Marseilles the generators were direct-driven by a high-speed, vertical, double-acting engine, but these were afterwards replaced by Corliss engines with rope driving.

Accumulator Traction.—The Lond. "Elec. Rev.," Dec. 28, discusses the recent criticism of Mr. Epstein. It is claimed that 2½ sets of batteries per car is too close a margin of safety; at least three sets should be used; "it is this very practice of inventors claiming too much for their cells which has been chiefly the cause of failure in battery traction."

Light Railways.—The conclusion of a paper, by Mr. White, on this subject is published in the Lond. "Engineering," Dec. 28; he gives detailed items of the cost of some existing railways.

Trolley Balloon.—The "Elek. Anz.," Dec. 16, gives an illustrated description of the model of the balloon which was intended to be operated (but failed to do so) at the Antwerp exhibition last year.

Analysis of Electrolyzed Pipes.—A paper, by Mr. Rigge (Omaha), is reprinted in "L'Elec.," Dec. 28. He gives the results of some measurements of the voltage and current in the earth return; the article contains, word for word, the description of the analysis attributed in another journal (see below) to Mr. Furay. As a remedy against electrolysis he suggests reversing the current frequently, "if it were safe and possible;" it is impracticable to insulate the pipes, and the only practical way which occurs to him is to weld the rails or to bind them with one-inch copper wire. He suggests that frequent voltage measurements should be made all over the line, and that changes in the return conductor should be made as the measurements may indicate.

Air Brake.—An illustrated description of the Genette brake (Chicago) for street railways is published in the Lond. "Engineering," Dec. 28.

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Fuel Consumption.—The "Eng. News," Jan. 10, abstracts from a report of Mr. Parsons, Chief Engineer of the Rapid Transit Commission of New York, some statements regarding the comparative fuel consumption on electric and steam railways. One of the chief advantages in favor of the electric railway is due to the greater efficiency of the fuel; with the ordinary locomotive five pounds of coal are usually consumed per hp per hour, while a large stationary plant could be run with 1¾ to 2½ pounds, and at the same time the stationary boilers can be adapted to the burning of cheap fine coal of an inferior quality. He gives the following table, in which the weight of the train includes that of the passengers; the first three are electric roads, and the others steam:

Railway.	Weight of train, tons.	Coal per train mile, lbs.	Coal per ton mile, lbs.
Liverpool Overhead	42.0	17.5	.416
Intramural	74.0	36.6	.495
City and South London	44.0	28.0	.604
Manhattan (1)	80.8	49.2	.609
Brooklyn Elevated Railway (2)	63.0	42.0	.661
Manhattan (3)	97.1	51.3	.528
Brooklyn Elevated Railway (4)	91.5	48.1	.526

Note.—(1) Ninth avenue train with an average of 3.77 cars. (2) Short train averaging 2.74 cars. (3) All trains averaging 4.50 cars. (4) All trains averaging 4.54 cars.

The better showing of the Liverpool road over the Chicago Intramural is due mainly to the difference between a permanent and a temporary plant; the poorer showing of the City and South London line is due to the use of non-condensing engines, which is estimated to increase the coal consumption 20 to 25 per cent.

Traction.—A part of the discussion of the recent Institution (London) papers is contained in the "St. Ry. Gaz.," Jan. 5. (The whole of this discussion was abstracted in the Digest, Dec. 29, Jan. 12 and 19).

Steep Grade Traction.—Mr. Preller's recent Institution paper (see Digest, Dec. 15), is reprinted in full in the "Elec. Age.," Jan. 5.

Accumulator Traction.—The second and last part of the paper by Mr. Gibbings is published in the "St. Ry. Gaz.," Jan. 5. The whole paper is also reprinted in the "Elec. Rev.," Jan. 2.

Bicycle Railway.—According to the "Eng. News," Jan. 3, a bicycle railway, operated by storage batteries, is being built at Waterport, New York, of which a short section has been put in operation for exhibition; the car carries 25 passengers, and runs on a single rail.

Horse Power for Car Propulsion.—Some simple rules for calculating the hp for propelling cars are given in the "Eng. News," Jan. 10.

Electric Braking of Motor Cars.—Mr. Smith's article (see Digest, Jan. 5) is concluded in the "St. Ry. Gaz.," Dec. 29. He discusses the action of the electric brake, consisting of the motors used as dynamos, and mentions the Sperry brake; he believes that future progress in motor car brakes will be in this line; regarding the strain on the gears, he believes that if they are able to transmit the power to start the car in the short time in which most motor men force them to do it, they certainly will not be damaged by the stress due to electric braking. He explains the curious fact that when an electric brake, such as he describes, is applied, one pair of wheels will sometimes revolve in the same direction continuously, while the other pair revolves alternately forward and backward until the car comes to rest. He believes that a systematic investigation of the subject of electric braking will repay careful study.

Double vs. Single Trucks.—In an article by Mr. Brill, in the "St. Ry. Jour." for January, he discusses the objections to the usual double truck cars and states the advantages of the maximum traction truck for long cars; each of the two trucks contains a large pair of driving wheels, and a small pair of trailing or guide wheels; it overcomes all oscillation and pounding; 87 per cent. of the weight is on the driving wheels; the braking action is said to be very good. In his opinion 18 ft. cars are the longest that should be used on 4 rigid wheels.

Uses of Trolley Cars.—In a short editorial on the progress of electric traction, in the "Eng. News," Jan. 10, it is stated that over 62 electric street railways in the United States now carry mail, sometimes in specially equipped postal cars; the freight and express service is rapidly extending, and is now being furnished on nearly 50 separate roads; in Toronto the city garbage is hauled away on electric cars.

Trolley Car Accidents.—According to the "Eng. News," Jan. 3, 98 persons have been killed in Brooklyn since the introduction of electric traction in 1892, and several hundred were injured; for the year ending July 1, 1894, there were in that city 122 accidents, of which 40 were fatal.

Street Car Fenders.—A number of the latest fenders are described and illustrated in the "Eng. News," Jan. 3.

Electrolyzed Water Pipes.—An abstract of a paper, by Mr. Furay, read at the Montreal meeting of the Fire Chiefs, is contained in the "Elec. Age," Jan. 5. He gives the result of an analysis of the material found on underground iron pipes, that had been acted on by the current; he found that the specific gravity was very small, 1.88; the material it contained about 56 per cent. of iron, 29 of graphite, 1 of manganese, 13 of silicon, besides sulphur phosphorous, etc.

Motor Repairs.— A third paper by Mr. Hobart, with illustrations, in the "St. Ry. Jour.," for Jan., gives practical instructions for the handing and repairing of armatures of car motors.

Conduit Road.—A good illustration of the conduit of the Metropolitan road in Washington is contained in the "St. Ry. Jour.," for Jan.

Three Wire Trolley System at St. Louis.—According to Mr. Gotshall, in the "Elec. Eng.," Jan. 2, the three wire trolley system has been used by him for sometime in that city, and the difficulties that were first encountered have all been overcome; the rest of the system is to be changed to the three wire system.

Alpine Road.—The "Elec. Rev.," Jan. 9, gives some data about the proposed Jungfrau electric railroad, but it appears to include very little that has not already been given in these columns.

Philadelphia.—An illustrated description of the Hestonville, Mantua and Fairmount Electric road is published in the "Elec. Eng.," Jan. 9. A long and profusely illustrated description of the line of the People's Traction Company, in the same city, is published in the "St. Ry. Jour.," for Jan.

Power Station in St. Louis.—A description, accompanied by a number of illustrations of the station of the Lindell Company, is published in the "West. El.," Jan. 5.

Yosemite Valley.—According to the "West. El.," Jan 12, the construction of an electric railway to the Yosemite is to be begun.

Newark.—A well illustrated description of the new power station of the Consolidated Traction Company, of New Jersey, is contained in the "St. Ry. Jour.," for Jan.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Continuous vs. Alternating System.—A correspondent to the Lond. "Elec. Rev.," Dec. 28, in referring to the stations in London, says that there in no doubt that those who are connected with the direct current stations obtain a much more regular and reliable supply than those who use the alternating current; in the latter the difference in voltage between light load and full load of the transformers is another objection to the latter system as also the rentals charged for the primary apparatus; the existing meters used by the majority of alternating current companies will not register correctly the power absorbed by motors, arc lamps, choking coils and other apparatus of a like nature.

Mr. Swinton gives some figures regarding the cost of the mains and feeders for the Scarborough station. With the high tension transformer system the all day efficiency is low, and consequently the working expenses are high, while with the low tension system the loss is great only during the short period, but when it comes to capital cost this consideration works the other way; owing to the high efficiency of transformers at full load, and the comparatively small losses in the high tension main the maximum power need exceed very little that delivered to the lamps.

Rules and Regulations.—A translation of those proposed for Germany, mentioned in the Digest last week, is given in the Lond. "Elec. Eng.," Dec. 28.

Central Stations in Paris.—The Lond. "Elec. Rev.," Dec. 28, contains a very full abstract of the table in "Lond. Elec.," Oct. 25, mentioned in the Digest Nov. 17.

Fecamp.—A small central station in this French town, in which accumulators and turbines are used, is described in part in "L'Elec.," Dec. 22.

High Voltage Systems.—A report by Messrs. Kennelly, Bell & Cabot, on the high pressure wires in Concord, N. H., is reprinted in the "West. El.," Jan. 12, the following extracts from which may be of general interest. In a partial list of towns and cities in this country and abroad, in which alternating currents of about 2,200 volts are used within city limits, they name 47 towns; the second list in which alternating currents of greater voltage than 2,500 are used contains four names: Hartford, Conn., 4,000 volts, Pomona, Cal., 10,000, San Bernardino, Cal., 10,000, and Guadalajara, Mex., 5,000 volts. The rest of the report is chiefly of local interest. In their opinion the system of arc lighting circuits used in Concord, which is similar in pressure to those universally used in this country, is not a menace to lives and property if installed, operated and maintained in accordance with requirements of good practice; they consider all pressures over 500 as being capable of producing danger to persons and property, and that, therefore, the danger would be no less if the pressure were reduced from 2,200 to 1,100.

Successful Municipal Plant.—Under this heading some data of the operating costs for the plant in South Norwalk, Conn., is given in "Elec. Ind." for Jan.

Light and Power Station at Cornell University.—The "Sibley Jour.," for Dec., contains a descriptive illustrated article by Messrs. Ryan & Macomber, of the University light and power station, in which turbines for several hundred hp are used.

Frankfort, Germany.—An illustrated description of this alternating current station, one of the latest erected in Germany, is given by Dr. Haas in the "Elec. Eng.," Jan. 9.

Hints on the Building of Electric Plants.—In a second article by Mr. Armstrong, in "Elec. Ind.," for Jan., he discusses the subject of specifications.

Non-Arcing Lightning Arrestors.—A well illustrated paper, by Mr. Wurtz, is published in the "Tech. Quart.," for July. It is substantially the same as his subsequent Institute paper.

Ferranti Rectifiers.—The illustrated description mentioned in the Digest, Jan. 5, is reprinted in the "Elec. Rev.," Jan. 2.

WIRES, WIRING AND CONDUITS.

Fastenings in Walls.—The Boeddinghaus system is described and illustrated in the "Elek. Zeit.," Jan. 27. A comparatively small hole is drilled in the plaster of the wall, and an open spiral of wire is then inserted and cemented with plaster of Paris, the space on the inside of the spiral being left free; screws for insulators or fastenings can be then screwed directly into this spiral. It appears from the illustrations that the spiral is left handed, and that its pitch need therefore not correspond with that of the screw to be introduced.

Conduit Wiring.—Mr. Noll, in the "Elec. Eng.," Jan. 2, points out the advantages of the use of iron conduits for house wiring; he recommends the use of twin conductors in these tubes in place of two single wires; these conductors have two systems of insulation, one inside the conduit and the other on the wire.

Legal Status of Electric Wires in the Street.—An article on the subject by Mr. Fisher, is published in "El'ty.," Jan. 9.

ELECTRO-PHYSICS AND MAGNETISM.

Electrical Polarized Rays and Electrical Resonance.—A paper by Mr. Zehnder from the "Weid. Ann.," vol. 53, page 505, is abstracted briefly in the "Elek. Zeit.," Dec. 27. He discusses how the rays may be polarized by replacing the reflecting mirrors in the Boltzmann interference researches, by two wire gratings such as those used by Hertz, by means of which interference or other phenomena can be produced.

New Method of Obtaining Line Spectra.—A new method described very briefly in the Lond. "Elec. Rev.," Dec. 28, is to pass a condensed spark between two platinum wires or carbon rods the tips of which are covered with the substance whose line spectrum is to be ascertained; if the condenser is not used the material inflames.

Electromotive Phenomena of Physiology.—The Lond. "Elec. Rev.," Dec. 28, abstracts at some length a paper by Mr. Reid, from "Science Progress," which it recommends very highly; he reviews the existing knowledge of the electromotive phenomena of glands and criticizes the theories which have been offered.

Temperature of the Arc.—The paper mentioned in the Digest last week is abstracted briefly in the Lond. "Elec.," Dec. 28.

Symmetry of the Magnetic and Electric Fields.—A long paper by Mr. P. Curie is contained in "L'Eclairage Elec.," Dec. 25.

Magnetization of Iron and Nickel by Rapid Electrical Oscillation.—A paper by Mr. Klemencic, from the "Weid. Ann.," vol. 53, page 707, is abstracted in the "Elek. Zeit.," Dec. 27. Electrical oscillations are dampened much more in iron wires than in non-magnetic metals, due to the fact that the surface conduction is less; as the generation of heat is proportional to the resistance, the resistance to the passage of electric waves may be determined from the heat, and the permeability can then be calculated; two parallel wires were used, one of iron, and the other of brass, the heat being measured in each case; the permeability will then be equal to the square of the ratio of the heat in the two wires, multiplied by the specific resistance of the brass, and divided by that of the iron; in this way he obtains as the permeability for iron 118, for soft piano wire steel 106, hard 115, Bessemer steel, soft 77, hard 74, and nickel 27.

Electromotive Force With Magnetization.—An academy paper, by Mr. Hurmuzescu, is reprinted in the "L'Ind. Elec.," Dec. 25. If two electrodes of the same magnetic metal are immersed in a liquid which attacks them, and if there is a difference in their magnetization, an elec-

tromotive force is produced; this has been noticed by others, but they did not agree regarding the direction or polarity of the E. M. F., the present experiments were made to determine this. He develops the formula theoretically from the principle of the conservation of energy; with iron the magnetized electrodes is always positive; he gives a table of the values, for instance, for 126.3 lines of force per square cm, the E. M. F. was 44 millivolts, for 306.8 it was 155, and for 704 it was 229. For nickel the polarity is the same; for bismuth the magnetized electrode is negative.

Influence of Magnetism on Germination.—Attention is called in the Lond. "Elec. Rev.," Dec. 28, to an article by Mr. Tolomei, in "Malpighia," 1894, page 470, on the effects of magnetism on the germination of the Phaseolus Vulgaris. He found that a feeble magnetic field had no appreciable effect on the germination of the seeds, while a field of greater intensity caused more or less increased rapidity of growth, in proportion to the proximity of the growing seeds to the point of greatest magnetic intensity; young plants were found to be diamagnetic. The journal suggests that such results should be accompanied with quantitative data, so as to give a more accurate notion of the conditions.

Effects of Magnetization on Volume.—The Royal society paper of Mr. Bidwell, mentioned in the Digest Aug. 25, is published in the Lond. "Elec. Eng.," Dec. 28.

Large Electromagnet.—An article from the New York "Sun," describing some experiments with Col. King's large magnet at Willett's Point, N. Y., is reprinted in the "West. El.," Jan. 5. According to this description, the magnet core consisted of an old Rodman 15-inch gun, weighing 50,000 pounds; it was turned into a club-footed magnet by the addition of many tons of heavy iron plates; the coil consisted of old torpedo cables 14 miles long, carrying 20 to 25 amperes; the armature consisted of 6 platform plates bolted together; a calculated force of 44,800 pounds was insufficient to tear off the armature, the chain used being broken by the strain; 5 cannon balls, of 325 pounds each, were suspended like a chain from the muzzle of the gun; an iron spike placed against the breast of a man standing three or four feet off, with his back to the gun, stood out straight; it required the efforts of two men with a sudden jerk to pull away a 25-pound bar from the gun; with its carriage the gun weighs 80,000 pounds; at a distance of 71 feet the magnetism of the gun equaled that of the earth, a compass needle being deflected 45 degrees, at a distance of 300 feet it was deflected 3 degrees.

Curious Magnetic Phenomena.—A description of the phenomena recently noticed by Mr. Lloyd (described in the Digest Dec. 15), is published in the "Elec. Rev.," Jan. 29, by Mr. Stone, who adds a mathematical discussion of it, which he says accounts for it quite satisfactorily, if the reluctance at the fracture is greater than that for the rest of the magnetic circuit. (The compiler calls attention to an abstract in the Digest 29, in which the phenomena was explained.)

Three Phase Currents.—The "Tech. Quart.," for July, mentions, but does not describe the "beautiful apparatus with which Prof. Puffer illustrates the effects of three phase currents."

What is Electricity?—Mr. Walker's paper (see Digest, Dec. 22), is reprinted in the "Elec. Age," Dec. 29.

ELECTRO-CHEMISTRY AND BATTERIES.

Purification of Sugar.—"L'Elec.," Dec. 15, abstracts an article from the "Rev. Ind." It states that it is difficult at present to give an opinion on the future of the electrical method, as the practical results are not yet sufficiently numerous nor sufficiently positive, but it appears certain from the experiments of Dr. Bersch, in Austria, and of the industrial applications of the Schoolmeyer, Behm & Dammeyer process in Germany, that the electric current exerts a true purifying action on beet juice; the nature of the electrodes is not a matter of indifference; the first cost of the installation is but slight, the process simply completes the purification by carbonate of calcium, it requires less chalk, simplifies the work, and gives a higher efficiency. The process of Javaux, Gallois and Dupont is described in detail; the liquor is purified so that one can obtain all the sugar which it contains in the form of white sugar without requiring treatment with carbonic acid, and without the production of molasses; after adding the chalk it is heated to about 90 degrees C., and should be slightly alkalined, to prevent the partial inversion of the sugar, and to precipitate a large part of the impurities; after filtration it is submitted to the action of an electric current in two series of compartments, separated by porous diaphragms, from a compartment containing water; the annodes in the first liquor are made of plates of oxid of manganese, or of aluminum, for the first series, and of plates of lead for the second series in which the liquor arrives after leaving the first; the cathodes, for the negative compartment filled with water, can be made of carbons, iron or other material insoluble in alkalies. The current decomposes the foreign material, and the acids set free are fixed by the annode while the basic products pass into the compartment containing the water; it is well to submit the liquor first to the action of the annode of the oxid of manganese, as the first acid elements set free by the current forms with the annodes combinations, which are completely insoluble, while the lead which is easily regenerated is better for the final action; if lead was used for the first application, soluble lead salts may be formed with certain liquors; the last traces of soluble lead salts may be eliminated by phosphoric acid.

Purification of Acetic Acid.—The Lond. "Elec. Rev.," Dec. 28, quotes from a Russian journal to the effect that an electric process was started in 1893, by means of which over 500 tons of acid were purified with such success that the old copper apparatus was abandoned; no details are given, but the English journal states "in our opinion, this mysterious box is nothing else than an imitation of the platinum apparatus, invented by Messrs. Johnson and Mather, which works so remarkably well for the concentration of sulphuric acid and other liquids by heat generated by electricity, and which consists of a platinum rectangular pan, fitted internally with insulators, holding the necessary platinum heaters."

Hermite Process.—An apparatus for generating small quantities of the sterilizing liquid, using currents from lighting circuits, is described and illustrated in "L'Ecalirage Elec.," Dec. 15. It appears to be the same as that described in the Digest, Sept. 22.

Cyanide Process of Extracting Gold.—Another article on this subject, by Mr. Andreoli, is published in "L'Eclairage Elec.," Dec. 15, it is devoted to a discussion of the recent litigation in England.

Reduction of Aluminum by Carbon.—An Academy paper, by Mr. Moissan, describing this process in his electric furnace, is reprinted in the "L'Ind. Elec.," Dec. 25.

Thermo-Chemical Actions in Accumulators.—A paper by Mr. Streintz, from the "Weid. Ann.," vol. 53, page 698, is abstracted in the "Elek. Zeit.," Dec. 27. The chemical energy is due to the sulphating of the lead, neglecting secondary actions, such as the absorption of hydrogen, in their negative plate, the generation of free gases, and the formation of hydrated lead oxid. To calculate the chemical energy he divides it into three phases, in the first water it is decomposed, requiring 684 calories, in the second the oxygen oxidizes the negative plate, and the hydrogen reduces the oxid on the positive plate forming water, the former developing 503 calories, and the latter an unknown quantity A.; in the third, sulphating takes place on both plates, developing 234 calories; the quantity A was determined by him experimentally, and was found to be 583; by summing these, he obtains a voltage of 1,885, assuming a constant in Faraday's law of 96,540 coulombs, and the unit of electrical energy as 0.00239. This is under the assumption that all the acid in the solution is used up; with dilute acid he obtained experimentally an E. M. F. of 1.900, and he therefore concludes the close agreement is not an accidental one, but that it proves that the action is really as described. (A series of articles on the theory of accumulators, by the same author, were abstracted in the Digest July 1, Nov. 18, Dec. 9-16, 1893).

Electric-Phoebus Accumulator.—According to a very brief description in the "Elec. Eng.," Dec. 28, the grid holds the active material very firmly, and prevents it from falling; at a discharge of one ampere per kg the capacity was 14 ampere hours per kg of mounted electrodes.

Electrical Sanitation.—A United States consular report from Havre, France, reprinted in the "Elec. Age," Dec. 29, refers to the Hermite process (concerning which many abstracts were published in these columns). According to Mr. Dubosc, microbes may be divided into two classes, those which exist without air, and those requiring air; on the former the action of the chlorine compound is simple, as the freeing of its oxygen causes their instant death; regarding the latter he states that the fatty principles undergo a strong oxidation, which destroys the equilibrium of the chemical medium, thus causing them to perish. It appears that there is a doubt concerning the question of economy in this system. At present about one-half of most water supplies is wasted in flushing drains and sewers, etc., and it is quite conceivable that the use of electrolyzed sea water for these purposes would therefore add immensely to the store of potable water.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Comparing Specific Inductive Capacities.—The "Phil. Mag.," for Jan., contains an illustrated article describing a method, by Mr. Northrup, for comparing the values of the specific inductive capacity of a substance under slowly and rapidly changing fields; he gives the results for paraffine and glass. With but a few exceptions the refractive index has been obtained by others only for very short waves, and he suggests that Maxwell's relation may not hold good in many substances whose specific inductive capacity has been determined in steady or very slowly alternating fields; he therefore devised the method which he describes, in which the fields of force may be made to vary slowly or rapidly. The apparatus is described and illustrated in detail, and the theory given. For paraffine he found that the specific inductive capacity was 3 per cent. less in oscillating than in slowly varying fields, and that of plate glass was 6.2 per cent. less; he concludes that the change is much smaller than several observers have stated; if the apparatus is well made he believes it capable of giving accurate results.

Specific Inductive Capacities of Water, Alcohol, Etc.—In the "Phil. Mag.," for Jan., Dr. J. Hopkinson refers to the recent paper of Prof. Fessenden (see Digest, Dec. 22), in which it was claimed that the values found by many others are not correct; the present writer states that the

values said to be incorrect are not those of a single observer but of many whose results are in good accord; he quotes a number of these results, all of which, especially for certain liquids, deviate from Maxwell's law; he thinks much more evidence will be needed than Prof. Fessenden has given before the former results are doubted. In reply to the statement that water insulates as well as India rubber he states that the highest recorded resistance for water is far below this value; "anything appearing in the Philosophical Magazine carries authority, and if inaccurate is calculated to mislead."

Determination of Di-electric Constants.—Mr. Nernst's paper, mentioned in the Digest, Dec. 29, is abstracted in the Lond. "Elec. Eng.," Dec. 28.

Units.—In a paper by Mr. Mewes published in the "Elek. Zeit.," Dec. 27, he discusses the relation between the electrostatic and the electrodynamic system of units in connection with the vibration theory; he describes Weber's fundamental principles of electrodynamics and makes deductions from them in connection with the vibration theory; the article is mathematical in character.

Physical Units.—In Mr. Maclean's serial, in the Lond. "Elec. Eng.," Dec. 28, he discusses the measurement of the units by their electrostatic and their electromagnetic effects, giving tables of the results of measurements of the ohm and the electrostatic units.

Units.—"Science," Jan. 4, contains an article of some length by Prof. Mendenhall in which he gives a brief review of the establishment of electric units, and of the recent electrical Congress. He gives the recent Act of Congress, number 105, approved July 12, 1894, which declares them to be the legal units for the United States; there are a few differences between these, and those adopted by the International Congress at Chicago, but he states that they are very slight "and consist entirely of verbal changes that were thought to be desirable and necessary by the Senate committee to which this bill was referred after its passage by the House of Representatives." In conclusion he adds that "one cannot refrain from the opinion that from an absolutely metrological standpoint the regulations of the 'Order in Council' should be condemned rather than approved, etc."

Measuring Large Currents.—The "Tech. Quart" for July mentions but does not describe an apparatus by Prof. Holman and Mr. Laws, "for the measurement of currents up to 300 amperes with an accuracy never before obtained in such measurements."

TELEGRAPHY, TELEPHONY AND SIGNALS.

Peculiar Telephone Troubles.—In an article by Mr. Mix, in the Lond. "Elec.," Dec. 28, he describes some peculiar disturbances which were noticed at Odessa. A theatre had been lighted with alternating currents from a distant station, one having a frequency of 40 and the other of 125, the total power consumed at the theatre being 80 kw; with the low frequency current the disturbance on telephone circuits (the American Bell instrument being used) were insignificant, but when the higher frequency currents were used the disturbance became quite important on lines running in the neighborhood of the theatre. The cause was found to be due to the fact that the wiring of the galleries of the theatre for lighting was run on the loop system, that is, the current entered at one end of the loop circuit and left at the other, for the purpose of having an equal potential on all the lamps of that circuit, the effect of the current being therefore the same as if a single conductor were placed around each gallery and the current was exceptionally large, as the voltage was only 60; the four circuits encircling the theatre in this way produced a very strong magnetic field whose axis was that of the theatre, and it was this field that acted in the telephone wires; it is likely, also, that the iron roof added to the effects in concentrating the lines of force which escaped from the edges of the roof and cut the neighboring wires; the remedy of course is to abandon the loop system; (another remedy, although not as perfect, which suggests itself to the compiler would be to reverse the connections of every alternating loop, in which case the current impulses would be in alternately opposite directions). He also shows the importance of electrostatic induction effects on telephone lines; a single wire forming one line of a new branch from a primary circuit of an alternating current system ran parallel to a group of telephone lines for a distance of about 1,200 feet, the telephone lines being on the opposite side of the street, 60 feet distant; there were no transformers on the branch line, the only current in it being that due to the charging of the line; this caused important disturbances on the telephone circuit, which, however, ceased when the second branch line was also connected; the effect was therefore purely electrostatic; the disturbance was so great as to almost completely prevent communication. He concludes that electrostatic induction is quite as capable, if not more so, of creating telephone disturbances than electromagnetic induction.

Long Distance Telephony.—According to the "Elek. Zeit.," Dec. 27, the Berlin-Memel line has just been completed; it is 1,020 km (about 617 miles) long thus forming the longest line in Europe; it is stated that this line proves that it is possible to construct long distance lines without the expenditure of such large amounts of money as was required for the New York-Chicago line.

Theatrophone.—"Rev. Ind.," Dec. 22, publishes an illustrated description of the system in use in Paris, by means of which any telephone subscriber can be connected with any one of a number of the theatres in Paris.

Information Office.—According to the "Elek. Zeit.," Dec. 27, an office has been established in connection with the large telephone station in Paris, where any question or complaint regarding the service are to be addressed; any subscriber can be connected with this office.

Telephone.—The instrument described in the Digest, Dec. 8, is illustrated and briefly described in the Lond. "Elec.," Dec. 28.

House Telegraphy and Telephony.—The continuation of Mr. Oesterreich's article, describing some new apparatus, is contained in the "Elek. Zeit.," Dec. 27.

Muirhead vs. The Commercial Cable Co.—A discussion of this important litigation is contained with illustrations in Lond. "Engineering," Dec. 28. Judgment was given a few weeks ago, reversing the decision of Justice Kennedy, declared in May.

Wheatstone Automatic in the United States.—An article by Mr. Finn, with some tabulated data, is published in the "Elek. Zeit.," Dec. 27.

Gilgit Telegraph Line.—The Lond. "Elec.," Dec. 28, reprints an article from the "Indian Engineer.," giving a description of this line, which is of interest, because it passes over two very high mountain passes.

Fire Alarm Telegraph.—A German system is described and illustrated in the "Elek. Echo," Dec. 29.

Waterproof Electric Bell.—A new form is described and illustrated in the "Elek. Zeit.," Dec. 27, which can be run for months under water. The magnet and the contact braker are enclosed in a hermetically sealed box; the poles of the magnet project to the outside, where they operate on the clapper as usual, but the contact is made and broken by a second armature enclosed in the box; the two armatures, therefore, vibrate synchronously.

Telautograph.—According to "the West. El.," Jan. 12, Gray's telautograph was used successfully, on Dec. 15, on the long distance telephone line between Paris and London, 312.5 miles long, of which 23 are submarine cable; the resistance of the circuit was 706 ohms, and the capacity 11 microfarads; the speed was 18 words in 36 seconds, at one time, and 22 words in 40 seconds at another, each word averaging five letters; the writing was perfectly legible, but somewhat ragged at very high speeds.

Telegraphing Signatures.—An article of a popular nature, by Mr. Perry, is published in "El'ty.," Jan. 9.

MISCELLANEOUS.

Magnetic Separation of Iron and Zinc Ores.—A well illustrated description, by Mr. Ferraes, of an installation in Sardinia, is published in "L'Eclairage Elec.," Dec. 15. A product, which was of no use, although it contained 26 per cent. of zinc ore, is treated in a furnace so as to oxidize the iron ore into a magetic oxid, after which it is treated with a magnetic separator; the material must be finely ground; the three furnaces can each treat 12 tons per day, with an expenditure of 2 tons of coal; the installation was started in 1890, and in the first year 5,000 tons were treated, furnishing 1,530 tons of concentrated ore, having 41.7 per cent. of zinc; at present it is concentrated to 45 per cent.; in addition very pure iron is also produced.

Educational.—The Lond. "Elec.," Dec. 28, reprints and discusses an article by Sir Philip Magnus, on the question of whether examinations are a mere necessary evil.

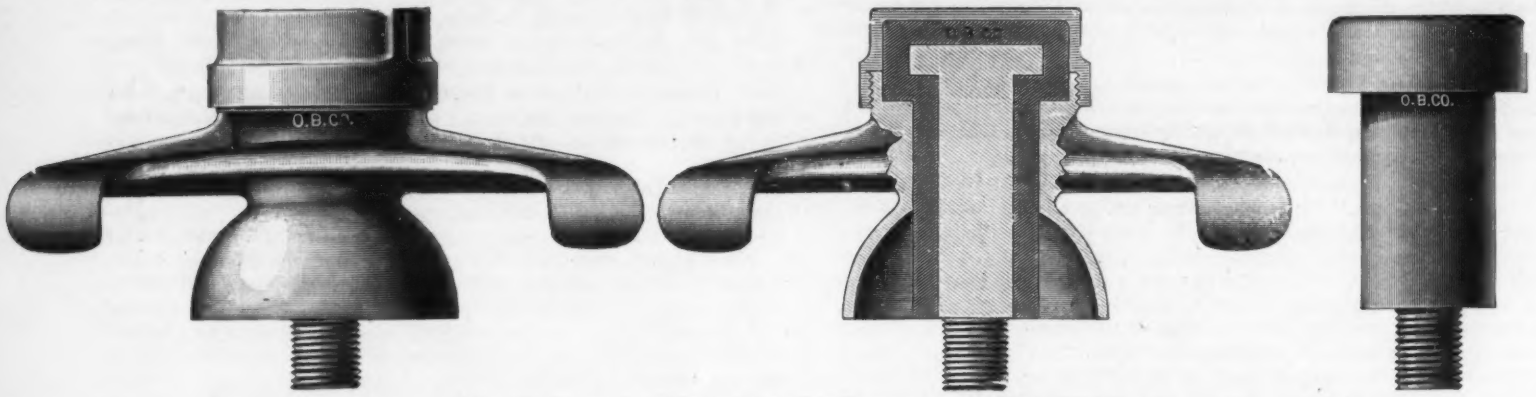
How Does Electricity Kill?—The "Elec. Eng.," Jan. 2, contains a paper on this subject by Mr. La Roche. He relates several cases in which he himself was subjected to high voltage currents, in which he estimates that two and more amperes passed through his body. He describes a test made with a cat, and another with a fox, in both of which the animals were killed, the former with comparatively few shocks of longer duration, while with the latter they were numerous, but of shorter duration. Shocks of prolonged application probably cause disintegration by electrolytic action, but the second method is more certain and quicker; to destroy animal life he concluded that the best method is to shock the body in quick succession, with many shocks, for about 30 seconds, with either a direct or an alternating current of 1,200 to 1,500 volts. He states that it has been demonstrated (when and by whom?) that a current from 1 to 10 amperes (for what length of time?) does not destroy any of the vital organs, but that it takes currents from 10 to 20 amperes (have not a number of linemen been killed with a 9 ampere arc light current?) smaller currents, no matter what the voltage, simply cause suspended animation. He believes that an intermittent direct current not greater than 60 is more deadly than an alternating current of an equal E. M. F., "with an alternating current of high frequency, say, 16,000, a body would act as a condenser, choking back the current, and the higher the frequency of the alternations, the greater the impedance to the current, so that after the first contact was made there would be no sensation of current passing, because the great frequency would prevent the body from returning to zero (sic), its normal state."

Law of Invention.—An abstract of a Franklin Institute lecture, by Mr. Petit, with special reference to electrical cases is reprinted in the "Elec. Age," Dec. 29 and Jan. 5.

A New Type of Trolley Hanger.

A new type of trolley hanger is being placed on the market by the Ohio Brass Company, Mansfield, O., known as "Type K," and of which we illustrate, a straight line hanger in elevation and cross section, an insulated bolt, which is interchangeable with the different forms of hangers, and a single curve hanger. The complete line of "Type K" hangers includes all the various styles necessary to support the trolley wire for the different suspensions in general use.

The hanger is made of three parts, consisting of a body, cap and insulated bolt. The latter is a ⅝-inch drop forged steel bolt molded with a heavy covering of insulating material around it, and is thoroughly protected from moisture and accidental blows by the metal covering surrounding it. The cap, which screws on to the hanger body, bears directly on a leather washer, which is interposed between it and the head of the insulated bolt, and thus holds it securely in position. The design of the cap and threaded lip of the hanger body, which is peculiar to this type of hanger, permits the screwing of the insulated bolt into the trolley wire support, without raising it from its normal position in the hanger body, which is necessary in other forms.



Figs. 1, 2 and 3.—Straight Line Hanger and Insulated Bolt.

Waterproof Hydraulic Packings.

The constant demand for a superior packing for the plungers and pistons of pumps, pumping and hydraulic machinery, induced the Garlock Packing Company, Palmyra, New York, to produce a packing which would meet the necessary requirements, which it has finally succeeded in doing after many years of experiments and at a considerable expense.

Fig. 4.—Single Curve Hanger.

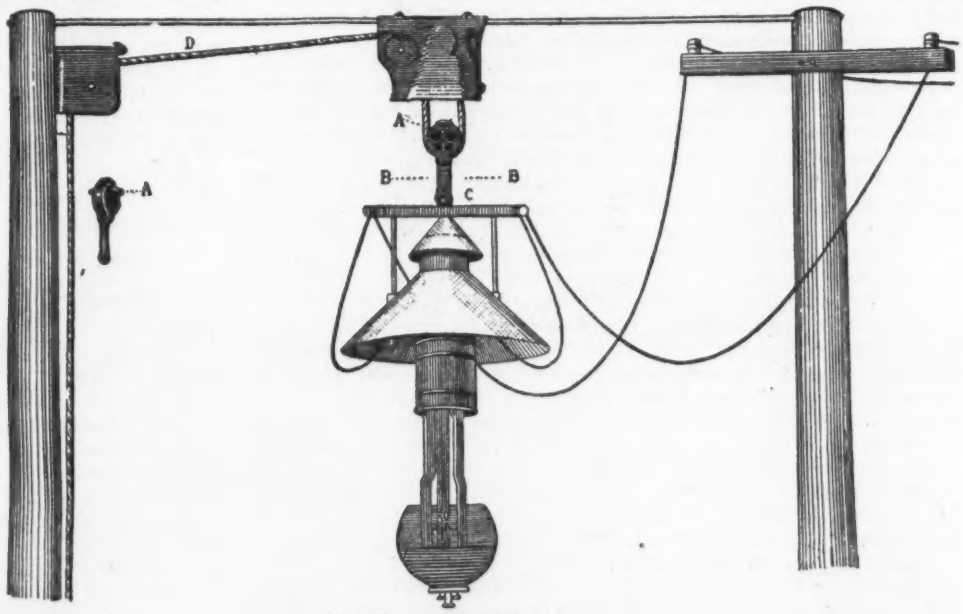
This packing is the outcome of numerous experiments and practical tests in the water ends of pumps, plungers, pump pistons, hydraulic elevators and hydraulic machinery, and with the result that the company now puts forth the claim with confidence that it it has produced a first-class waterproof packing for light or heavy duty, made of the best flax and thoroughly lubricated with a waterproof compound which is strictly free from acid. Heretofore, the best rawhide hydraulic packing answered its purpose well for a time, but soon became water-soaked and soft from the use of oils, losing its strength; and piston plungers were sure to leak badly, requiring constant repacking. This packing is intended to resist excessive pressures and retain its solidity. One of their principal claims for this packing is that it is absolutely waterproof and oil proof. Engineers who daily experience the difficulties of leaky pump plungers will no doubt greatly appreciate the advent of this packing.

Arc Lighting in the New York Herald Building.

The arc lighting of the new building of the New York *Herald* is one of the finest examples of this system of illumination in New York. The entire press room is illuminated with eight of the Clark Electric Company's ornamental arc lamps, and the same lamp is also used in the engine room, delivery department, and stereotype foundry. The manager of the *Herald*, and his electricians, Mr. Knight and Mr. Cecil began the investigation of arc lighting from incandescent current for their building ten months ago, and after nine months of trial of various makes of arc lamps, they selected that of the Clark Electric Company, 192 Broadway, New York, as best for their purpose. The lamps in the press room are of a special design, having a combinaton electric arc light and gas fixture. The New York *Herald* is the only newspaper in America that exhibits its entire printing presses where the public can stand upon the sidewalk and see the paper enter the press, come out printed and folded, ready for delivery. Thousands of people visit this establishment and watch the interesting process of producing the modern newspaper.

Safety Hook Pulley.

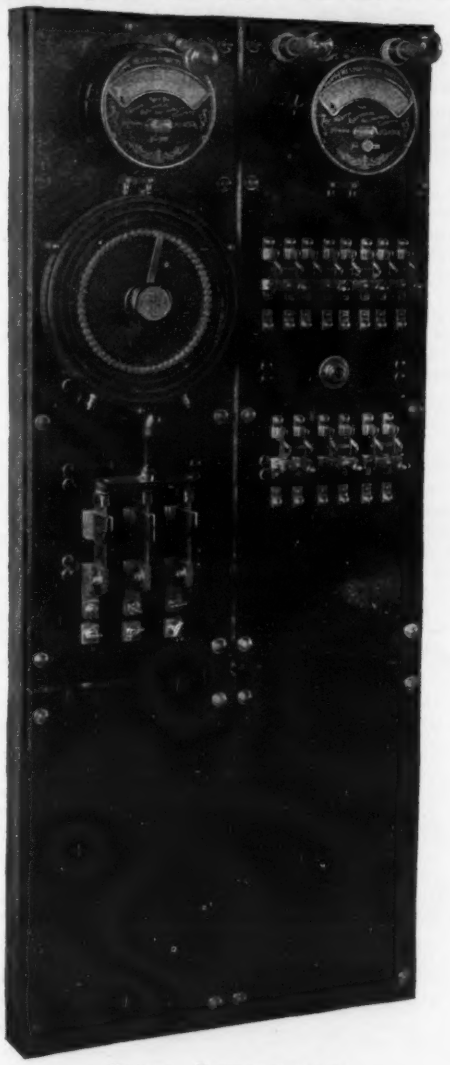
The pulley we illustrate, made by the Barber-Koenig Manufacturing Company, 117 North Vine street, Hazleton, Pa., is designed to obviate danger from falling lamps by relieving the rope by which the lamp is suspended of all strain. When the lamp is in position there is no strain whatever on the suspending rope, nor is there any of the twisting motion which is apt to cause the leading wires to break at the hook-cross arm. The casing of the pulley is made of cast iron, fitted with a rope pulley, and a slotted attachment for catching the lugs of the safety hook. In order to secure good alignment, the supporting guy wire passes through the casing, and is fastened to it. The safety hook "A" at the left of the cut is made of malleable iron, with projecting lugs for engaging with slots in the pulley casing. It is also fitted with a pulley, thus securing a double purchase on the rope, so that the lamp may be raised with ease. The cut shows a lamp lowered slightly, in order to illustrate the method of connecting the safety hook and double purchase on the rope.



Arc Lamp Suspension.

Isolated Plant Switchboards.

Advances made in the electrical art are nowadays all in the direction of economy, and the patient attention to details results now in the elimination of that expense now in the reduction of this. As an example, in isolated plant engineering the design and construction of the switchboard has generally occupied a large amount of time, with consequent expense, usually out of proportion to the size of the contract. To reduce this expense, the General Electric Company has standardized a form of switchboard, of panel type, similar in this respect to those successfully known in its railway work. The panels are of two kinds, one for the generator and one for the feeders. They are of black enamel slate in two finishes, mounted on a steel frame. Flanges on the frames permit of the panels being connected side by side to form one uniform whole. The generator panels are built in eleven capacities, running from 3 to 100 kw, at 125 volts, or from 24 to 800 amperes maximum, and all are 48 in. high, and 16 in. wide. Each generator panel carries one triple pole single throw switch with fuses, one Carpenter enamel field rheostat, one round dial ammeter, and a pilot lamp, all being electrically connected behind the panel. The common bus bars on all the panels



PANEL SWITCHBOARD.

being the same distance apart, connection of the bus bars by a copper tie bar connects the panels together electrically. Except in the method of connection, the three and two wire panels do not differ.

The feeder panels are made in two sizes, 48 in. high by 16 in. wide for the two wire, and 48 in. high and 26 in. wide for the three wire system. The two wire panel carries double pole feeder switches with fuses, one round dial voltmeter reading to 125 volts, one two wire push, button ground detector. The three wire panel carries triple pole single throw switches, with safety catches, two voltmeters, and one ground detector. All the connections are complete, and immediate installation is effected by soldering in the feeder ends and generator leads and connecting the two bars together with tie bars.

These switchboards are made for support either by brackets upon a hollow pedestal, or the framework may be continued down to the floor and the open space filled by blank panels, as shown in the illustration. This method is generally recommended.

The simplicity of construction and ease of installation of these panels, together with the advantage of increasing the capacity without impairing the uniform appearance of the switchboard, have already commanded a wide appreciation among electricians.

The Cummings & Engelman Conduit.

The conduit system of the Cummings & Engelman Conduit Company, Detroit, Michigan, has attracted wide attention, and we illustrate herewith an end and longitudinal section of the low tension system.

It is a draw-in system, carrying any potential on bare conductors up to 6,000 volts. In the manufacture of the conduit lap-welded iron pipe in 20-foot lengths is used, which is first dipped in an insulating varnish, a product of the compound used in filling in the space between the wooden ducts and the pipe. The ducts are made from kiln-dried wood in 20-foot lengths, which are then boiled in oils, thus thoroughly saturating the wood and killing all the fiber. They are then spirally wound with a rope prepared in the same oils. Any number of these ducts may be grouped together, yet separated by the windings, and collectively held together by an outside spiral binding, thus not only holding the ducts together, but, also, forming a space between them, individually, and, after they have been placed therein, between them and the inside surface of the pipe.

After a group of the wooden ducts has been placed in the iron pipe or tube, an insulating plug, two inches thick, is driven in flush at one end

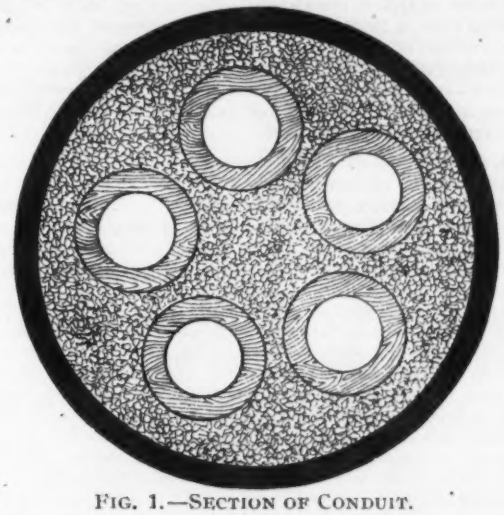


FIG. 1.—SECTION OF CONDUIT.

of the pipe, the ducts only entering this plug ½ inch, thus leaving an unoccupied space of 1½ inches in the exposed end of the plug. Consequently the ducts project the same distance (1½ inches) beyond the other end of the tube. Each plug has a number of openings corresponding to the number of ducts inserted in the tube, each duct entering its separate and designated hole. The iron tube is now raised to an angle of 45 degrees, and an insulating compound is forced in from the top until it fills completely all space between the ducts and between them and the inside surface of the pipe. After the compound has set, a 1-inch plug is then driven over the projecting ducts until it is flush with the end of the pipe. Thus the male and female joints are formed. Then the tube is lowered and ready for shipment.

In laying the conduit a trench is excavated to a depth of two feet

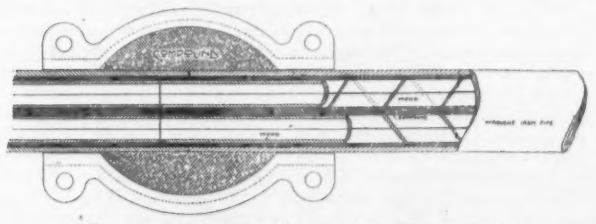


FIG. 2.—CONDUIT JOINT AND COUPLING.

below the grade of the street and of a width sufficient to accommodate the size of the conduit. Any number of conduits may be laid in a single trench. The conduit, Fig. 1, is laid in sections, each joint being completed after the projecting ends of the ducts have been slipped into the plug of the next tube, by means of a turtle-shaped cast-iron box, which, after it has been adjusted about the joint, is securely bolted thereto and an insulating compound poured in. Thus water and moisture are prevented from entering the tube at the joints.

A special feature of the system is the iron junction box, to which the tubes are joined. These junction boxes are provided with two covers, the outer cover being flush with the street, while the inner cover is bolted against a gum gasket, preventing water or moisture from entering the box. The boxes are made in various sizes, and have from two to six stubs. Moreover, the bare conductors are thoroughly protected in these boxes, so that is is possible to open them for any purpose, at any time and in any kind of weather.

As distinguished from other systems, this conduit, when properly laid need not be disturbed during the life of the tube, thus avoiding expense for repairs. Another feature of the system is the saving of money and time in laying the conduits.

NEWS OF THE WEEK

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 12, 1895.

ELECTRICAL STOCK MARKET news, these days, considering the apathy characterizing the entire financial district, has more to do with speculation regarding the future of the trade and its problematical effect on prices than with the course of quotations themselves. Fluctuations such as really occur cannot be relied upon as furnishing any real indication of the conditions governing the operations of the electrical manufacturing and operating companies treated of. One must rather turn to the specific outside news of trade happenings to gain any idea of the companies' progress or otherwise, leaving the course of stock market quotations to merely give a record of the whims and caprices of fraction-scalping stock exchange traders.

GENERAL ELECTRIC'S quotations, for instance, vary so little or so purposelessly as to leave one no genuine idea as to how the General Electric Company is getting along financially and commercially. Not the least attention, in a stock market sense, is paid to such reports as ordinarily could be depended upon to create some activity in the stock, and judgments as to its value must be based on other things than what the ticker tape has to offer. It is beginning to be a generally conceded fact that the policy of purchasing its own debenture bonds is the best policy so far inaugurated by the General Electric Company's management. Already more than $1,000,000 of these securities have been put into the treasury, with the result that the capital impairment is being gradually reduced. In fact, what with the purchase of these bonds and the appreciation in value of other treasury assets, the large deficit has already been lessened one-third, with every indication of another large reduction soon being made. It is very likely, therefore, that beyond buying its own debentures and marking up the value of treasury assets as they appreciate in value, the officers of the General Electric Company will take no further action on the long-mooted question of making good the impairment in capital. Stockholders—and naturally so—have made strenuous objections all along to any proposition so far broached to reduce the capital stock proportionately so as to make up the impairment, and prefer to further postpone the dividend period rather than submit to any cutting down of their holdings. If profits hold out at the rate they are now being piled up and debenture bonds are bought in open market with the proceeds thereof, then the entire deficit can be made up within eighteen months by the mere operations of the company itself. And, when the impairment is fixed up, the stock will be really worth more than ever. For then the treasury assets will consist, to a large extent, of the bonds of the company, and the stockholders will also be the bondholders of the company, with a first lien on its property in any possible event of disaster. For this reason the principal stockholders prefer to wait a little while longer for the resumption of dividends on their holdings, feeling that when they are once again resumed under the present programme they will continue so uninterrupted.

WESTINGHOUSE ELECTRIC preferred and common stocks afford but little comment, to judge from the sluggishness marking their stock market course. Not that the company's own state of affairs warrants any such lack of attention to its securities. The Westinghouse Electric and Manufacturing Company is progressive and its management gives close attention to the company's affairs. Their latest move, according to Pittsburg advices, has been to prepare for the market a new type of alternating current machinery which is said to be "in many respects radically different from that now in use and especially so in the matter of superiority as to results. The main departure is in the construction of the armature, where solid copper bands take the place of the masses of wire heretofore used, saving the time, trouble and cost of winding, and giving a current of greater volume and steadiness, induction being practically done away with." Of course, these improvements are fully protected. Great things are expected of this new departure.

BOSTON ELECTRIC LIGHT 5 per cent. bonds, recently treated of in these columns, are being offered to the public at 102, the price subject to advance. Stockholders of the company subscribed for $100,000 worth of these securities, and $210,000 were sold to a New Haven banker, to be delivered from time to time as the company needs the money. About $50,000 have been further reserved by the company for stockholders who desire to subscribe but are unable to do so at the present moment.

AMERICAN BELL TELEPHONE stock continues weak around 190 to 192. The stock subscription fiasco continues to throw a cloud on the company. The latest information is that the directors have decided to sell the remainder of their stock at auction. About 3,300 shares remain unsubscribed for by stock holders. So far the date and details of the coming auction sale have not been made public, the whole matter being left to the discretion of the executive committee. There is a good deal of litigation ahead for the company, and it is likely that future stock market values will depend a deal on the result of the various cases in hand. For one thing, the appeal from Judge Carpenter's decision of December 18, in the Berliner Patent Case, to the United States Court of Appeals has been perfected, and the case will straightway be put on the calendar. Then suit has been brought against the Harrison International Telephone Company, of Chicago, to restrain the use of certain parts claimed to have been used by the Harrison Company. Upon the outcome of these suits will depend, to some extent, the future value of Bell Telephone.

ERIE TELEGRAPH AND TELEPHONE COMPANY report a net gain of seventy-nine subscribers in December; 284 for the three months ending December 31st and 672 for the fiscal year. The total number connected Juanary 1st are 16,085.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	98	100
* " " " Brooklyn	100	110	112
" " " Boston	100	122	124
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35	40
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7⅛	10
Fort Wayne Electric	100	1½	2
General Electric	100	34	34⅛
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	32⅛	33⅛
* " " pref	50	49¾	50

BONDS.

Edison Electric Ill., New York	1,000	108	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1 000	92¼	93

TELEGRAPH AND TELEPHONE.

*American Bell Telephone	100	190	191
American District Telegraph	100	35	40
American Telegraph & Cable	100	92	93
Central & South American Telegraph	100	102	105
Commercial Cables	100	138	145
Erie Telephone	100	53¾	54
Gold & Stock Telegraph	100	103	105
*Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	87⅛	88

* Ex div.

ELECTRIC TRACTION stocks traded in the New York market continue inactive. But each day furnishes another instance as to the growing importance of this class of securities and the increasing weight they will have in future comments on stock market news. For instance, the New York, New Haven and Hartford Railroad, one of the richest corporations in America, is about to introduce electricity experimentally as a motive power on one of its branch roads, with a prospect that, if successful, its use will be largely extended. President Clark has chosen the branch line running from Pemberton, near Boston, to Nantasket Beach, the Coney Island of the Hub, for the experiment, and on its success will depend the introduction of electricity as a motive power on the Warren and Bristol and other branches. "It may," he adds, significantly, "eventually be introduced throughout the entire system." Boston reports have it that there is a movement on foot there by a syndicate to form a street railway consolidation similar to the Metropolitan Traction of New York.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked.
Union Ry. Co. (Huckleberry)	115	120
Brooklyn Traction, pref	61	64
" " com	12	14
Long Island Traction	11½	12
Rochester St. Ry	30	40
Columbus St. Ry	45	50
Louisville St. Ry. pref	87	88
" " " com	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	68	70
North Shore Traction	23½	25
New Orleans Traction	63⅜	65
Worcester Traction pref.	80	82
" " com.	13	14
Metropolitan Traction, Philadelphia	101½	102
Philadelphia Traction	95	98
People's Traction	51	52
Binghamton R. R. common	100	—

BONDS.

	Bid.	Asked
*Union Ry. 1st. mtge 6s	105	108
*Westchester Electric 1st. mtge. 5s	98	101
Rochester St. Ry. 1st. 5s	95	97
*Columbus St. Ry. 1st 5s	95	97
Columbus Crosstown 1st. 5s	95	97
*Binghamton Railroad Co. 5s	99	100

*With accrued interest.

THE BINGHAMTON RAILROAD COMPANY report gross earnings for 1894 of $70,913; increase, $13,258. The net earnings for 1894 were $32,958; increase, $8,131; the operating expenses were decreased 3¼ per cent.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 Broadway, NEW YORK, Jan 14, 1895.

JAMES F. CUMMINGS, president of the Cummings & Engelman Conduit Company, Detroit, Mich., was in New York recently and called at the office of THE ELECTRICAL WORLD. Mr. Cummings reported that the company had recently acquired considerable new capital and expected to do a large business during the ensuing year.

THE KINGS COUNTY ELECTRIC LIGHT COMPANY has filed its articles of incorporation in the office of the County Clerk of Hudson County, and with the Secretary of State at Albany. The new company proposes to furnish Brooklyn with electric light, illuminate its parks, public and private houses, and to supply the town and villages in Kings County. The capital is $1,000,000, and the projectors are E. C. Low, of Brooklyn; P. G. Burr, of Amityville, L. I., and H. G. Adams, of Montclair Heights, N. J.

HERRICK & BURKE, electrical engineers, have recently organized with offices at 203 Broadway, New York, to do general designing, engineering and consulting work in the field of electric construction of apparatus and its installation. Mr. Herrick has been connected with electric lighting since 1879 and has had a wide and varied experience in this particular branch. Mr. Burke has had an active experience of six years in designing and constructing street railway and standard motors and generating apparatus.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, January 12, 1895.

THE PERKINS ELECTRIC SWITCH MFG. CO., of Hartford, Conn., has removed its New England office from 620 Atlantic avenue, Boston, to 182 Summer street, at which location it possesses ample facilities for the conduct of its rapidly growing business through this department. Mr. F. B. Smith, New England manager, "is the right man in the right place," has done an excellent business in the past and is confident of making a better record in the future, a result which he will unqestionably obtain through his untiring energy.

IT IS PROPOSED to operate by electricity the new harbor range lights to be established at South Boston.

THE REPORT THAT THE N. Y., N. H. & H'fd. R.R will equip certain of its Massachusetts lines with electricity is confirmed by Vice-President John M. Hall. Just to what extent the company will use the electrical system is not known, but it is regarded as certain that the Nantasket and Warren and Bristol branches will be thus converted and in operation by next spring, which will probably eventuate into an electric road between Providence, Fall River and New Bedford.

THE CUSHMAN ELECTRIC LIGHT COMPANY, of Concord, N. H., is a new company just organized for the purpose of manufacturing dynamos and motors under the patents of A. L. Cushman. The company succeeds the Granite State Electric and Machine Company, in which Mr. Cushman has been interested for a number of years. The new company will commence business at once, and as the Cushman motors and generators have already received handsome recognition, particularly in Concord and vicinity, it is safe to predict still greater success under the new order of things. Mr. Cushman possesses exceptional abilities in his particular line. The officers of the company are: President, B. A. Kimball, of Concord, N. H.; Treasurer, Ambrose Eastman, of Boston.

THE FOLLOWING OFFICERS of the Massachusetts Electrical Engineers' and Mechanics' Association were elected at a recent meeting: President, John A. Colcutt; Vice-president, Charles Toner; Financial Secretary, Louis Hoffman; Recording Secretary, J. B. Burke; Conductor, John M. Costello; Assistant Conductor, Harry Johnson; Chaplin, M. Daley; Inside Guard, Barney Toner; Trustees, J. E. Cole, J. L. Winnland E. Lunden. The regular annual ball will be held at Odd Fellows Hall, Boston, January 21, and is expected to surpass all previous efforts in this direction.

General News.

NEW INCORPORATIONS.

THE RALEIGH ELECTRIC COMPANY, Fayetteville, N. C., has been incorporated by A. A. Thompson, F. H. Briggs, and others, to establish an electric light plant.

THE GERSON ELECTRICAL MANUFACTURING COMPANY, Philadelphia, Pa., capital stock $50,000, has been incorporated by Charles Heritage and others, for the manufacture of iron or steel, or both, etc.

THE NYACK TRACTION COMPANY, Nyack, N.Y., capital stock $75,000, has been incorporated to build and operate a street surface road. The promoters are F. R. Bain, S. H. Brown, and T. F. Lawlor, Poughkeepsie, N. Y.

THE FOREIGN ELECTRIC TRACTION COMPANY, Alexandria, Va., capital stock $1,000,000, has been formed by Eppa Hunton and others, for the purpose of buying and selling patents covering electric railway systems, lights, etc.

THE ELYRIA, OBERLIN AND WELLINGTON ELECTRIC COMPANY, Elyria, Ala., capital stock $100,000, has been incorporated by W. B. Bedortha, Charles Metcalf, W. P. Steel, A. H. Johnson, and others. The line is to be 18 miles long.

THE FOREIGN ELECTRIC TRACTION COMPANY, Alexandria, Va., capital stock $1,000,000, has been incorporated to manufacture electric apparatus. W. M. Stewart, P. B. Thompson, G. Y. Atlee, and M. Wheeler, Washington, D. C., are interested parties.

THE SOUTHERN OHIO TELEPHONE COMPANY, Hamilton, O., capital stock $35,000, has been formed to erect and operate a system of communication by electricity, telephone or telegraph instruments. The promoters are Wm. H. Pfau, Frank P. Richter, F. W. Clements, C. C. Morey, and H. H. Haines.

THE FARNSWORTH PROPELLER COMPANY, Chicago, Ill., capital stock $2,000,000, has been formed to make or sell steam or electric propellers for water navigation; and to own real estate and buildings necessary for the shipbuilding business Addison Bybee, P. Malden and Fred. J. Patterson are the promoters.

THE KINGS COUNTY ELECTRIC LIGHT AND POWER COMPANY, Jersey City, N. J., capital stock $1,000,000, has been formed to manufacture and use electricity for producing light and power. Edwin C. Low, First avenue, corner Eighty-first street, Brooklyn, N. Y.; Henry R. Burr, Amityville, N. Y., and Hugo C. Adam, Montclair Heights, N. J., are interested.

THE CLEAR CREEK GOLD MINING AND WATER POWER COMPANY Denver, Col., has been organized by New York, Philadelphia and Colorado capitalists. Henry Levis, president, represents Eastern capitalists; Scott J. Anthony, vice-president, the Denver capitalists. The object is to supply power to run street cars, and all sorts of plants in Denver, by generating electricity at a point some miles distant.

TELEGRAPH AND TELEPHONE.

DETROIT, MICH.—The superintendents of the poor have decided to put in a telephone system at the county house, to cost $245.

DAYTON, O.—The police directors are inspecting the Chicago police telephone system, with the idea of adopting the same system in Dayton.

WABASH, IND.—The Phoenix Telephone Company, of Indianapolis, has been granted a franchise in this city, and has made an energetic canvass, securing 125 subscribers.

THE ERIE TELEGRAPH AND TELEPHONE COMPANY reports a net gain of 79 subscribers in December, 284 for the three months ending Dec. 31st, and 672 for the fiscal year. The total number connected Jan. 1st is 16,085.

ELECTRIC LIGHT AND POWER.

SAN PEDRO, CAL.—C. T. Deering, representing a Los Angeles electric light company, offers to furnish the city with ten lights of 2,000 candle power for $130 per month.

HENDERSON, KY.—A committee consisting of A. B. Hurt, John W. Muscaster and A. J. Miller are investigating the best system of electric light plant for the city.

NORTH AMHERST, O.—Bids will be received until January 30th for furnishing the city with electric lights for a period of not more than 10 years. Jacob Baus is clerk.

WORCESTER, MASS.—The Worcester Electric Power Company is said to contemplate selling current for heating and cooking. The company is considering plans for a new station.

LORAIN, O.—The Lorain Electric Light Company will expend $10,000 in improving its electric light station. Work on the improvement will be commenced as soon as the contract can be let.

EAST ORANGE, N. J.—The Township Committee of East Orange will endeavor to have a bill passed in the Legislature, allowing the township to build an electric light plant of its own.

WAUPACA, WIS.—Architect C. B. Pride, of Appleton, has completed plans for an electric light plant in this city. The buildings are to be put up early in the spring, as soon as the weather will allow.

MT. STERLING, KY.—John P. Martin, of Xenia, O., has been granted a contract by the city for the erection of an electric light plant, water works system and plant to operate an electric railway.

NEW LONDON, CONN.—David Banks, Alex. C. Robertson and Chas. W. Comstock filed, in the State secretary's office, a petition to the incoming Legislature for the incorporation of the Banks Gas and Electric Company of New London.

DENVER, COL.—The Clear Creek Gold Mining & Water Company has been organized to generate electric power. Scott J. Anthony, E. W. Rollins, President of the Rollins Investment Company, Dr. E. W. Smith, and others are interested.

PORTSMOUTH, N. H.—The citizens want all night lights, but are not anxious to spend $150,000 for an electric light plant of their own. The Electric Light Company will have to change over its entire system in order to adopt the all-night system.

RUTLAND, VT.—The subject is being discussed of establishing a municipal electric light plant. A private company proposes to furnish arcs for $112.50 per annum and 7½ cents per night for incandescent lights, to burn all night; a contract to be made for 10 years.

SALT LAKE CITY, UTAH.—The Citizens' Light Company has been incorporated by Charles Boettcher, of Denver, for $500,000. It will commence work at once, and is in the market for engines, boilers, wire, electric machinery, etc. Address, C. Boettcher, Denver, Col.

NORTHFIELD, VT.—G. R. Andrews contemplates putting in an electric light plant in Northfield. The business men in the place are anxious to see the scheme go through, and several have put their names down for lights. The power will be taken from the old Belknap mill.

BLACKSTONE, MASS.—The city government voted to offer the Woonsocket Machine and Power Company 40 cents per light, per night, for 29 arc lights. The rate now paid is 50 cents per light. The company says it will not accept the offer, and if not, the town proposes to erect a plant of its own.

QUINCY, ILL.—A new electric company, composed of John P. Wheeler, H. O. Channon and J. L. Fawcett, has been organized and will soon ask the Council for permission to put up the necessary poles and wires. This company will furnish incandescent and arc lights and will supply power for manufacturing purposes.

The Electric Railway.

NEWARK, N. J.—At the meeting of the Board of Works an ordinance granting permission to the Consolidated Traction Company to construct underground conduits on River, Mulberry and Market streets was introduced and passed to a second reading.

CHICAGO, ILL.—The Inter-Suburban Railroad Company is securing the right of way for an electric line running between the village of Highwood and Fort Sheridan. The Village Board and Highway Commissioners have been petitioned for the privilege.

WESTPORT, CONN.—The Westport & Saugatuck Horse Railway Company has petitioned the General Assembly to change its name to the Westport & Saugatuck Street Railway Company, and to amend the charter so as to permit it to operate its lines by electricity.

DETROIT, MICH.—A syndicate represented by James A. Randall, 43 Campau building, Detroit, has obtained the right of way and a franchise to construct and operate an electric railway between North Detroit and Pontiac, Mich., a distance of 25 miles.

FORT WORTH, TEX.—The Fort Worth Street Railway Company will spend $50,000 in improving and extending its line. Its track will be relaid with 56-pound steel rails, and it will also put in a new electric generator in its plant. G. Hendricks is superintendent.

SYRACUSE, N. Y.—The meeting of the Common Council will consider a resolution extending the time within which the Syracuse Consolidated Railway Company is to equip its remaining lines with electricity, under permission granted by the Common Council..

JERSEY CITY, N. J.—The West Side Republican League has decided to cooperate with the West Side Improvement League in trying to have the electric railroad extended down to Marion. Messrs. William Podmore, John Lockwood and Gustave A. Rhein are interested.

INDIANAPOLIS, IND.—The Presbyterian Association and State Synod has located a summer resort on Bass Lake, Stark County. An electric road is to be constructed from North Judson to Bass Lake Station. S. C. Dickey and G. W. Brown, of Indianapolis, are interested.

FORT PLAIN, N. Y.—A meeting was held at the Fort Plain Club rooms, to consider the advisability of building an electric road between this village and Canajoharie. Nothing definite was reached, but it is understood that another meeting will be held in the near future.

FORT EDWARD, N. Y.—The building of a cable road from the village of Caldwell to the top of Prospect mountain will be commenced soon. The road will be ready for business next summer, and will be a great addition to the many interesting features of Lake George.

COLUMBUS, GA.—Mr. John H. Drake, president of the Drake & Stratton Company, spent several days recently in this city in connection with the work on the new electric system, in which his company is largely interested. It was decided to add about two miles additional track.

WINDSOR LOCKS, CONN.—The Windsor Locks & Suffield Tramway Company, which was chartered by the last General Assembly, will petition the incoming Legislature for power to extend its lines from the north boundary of Windsor Locks through Boston Neck to Suffield.

ESSEX, CONN.—A trolley road from Essex to Centerbrook and Ivorytown Village, where the great ivory and bit manufacturing industry is located, is one of the possibilities of the future. There is talk of extending the line to the seashore resort of Westbrook, a distance of five miles.

COLUMBUS, IND.—By a majority of 43 the proposition to aid in the construction of an electric railway from Indianapolis to Franklin, 20 miles from this city, carried. The amount of bid voted was $34,000. The road is now assured, to parallel the Louisville division of the Pennsylvania lines.

HOT SPRINGS, ARK.—The scheme to build an inclined cable railway 2,000 feet long up West Mountain has been revived by forming a $300,000 company. S. W. Fordyce, of the St. Louis, Southwestern Railroad, and B. F. Small Co., St. Louis, have become interested G. W. Baxter is the promoter.

WASHINGTON, D. C.—Calderon Carlisle, H. L. West, W. P. C. Hazen and others are promoting an electric road to run along M street, Virginia avenue, 12th street, and Tennessee avenue. The company is to have $50,000 capital, and is to be called the East Washington Belt Line Railway Company.

ANNAPOLIS, MD.—H. Yewell Bready, engineer of the Annapolis & Bay Ridge Electric line, has stated that the road will be about five miles long, and that work on it is to begin about January 1. J. C. Musgrove, of Philadelphia, is president. The motors will be 25-hp and the rails 80-pound steel.

ALLENTOWN, PA.—A corps of civil engineers, in the employ of the Inter-County Electric Railway Company, has staked out a road from Summit Hill to Mauch Chunk, via Nesquehoning. The road will connect with the Carbon County Electric Railway at the east end of the East Mauch Chunk bridge.

DETROIT, MICH.—The Detroit Citizens' Street Railway Company is having estimates made of the cost of changing about 25 miles of its lines in this city from horse to electric power. The change will probably be made this winter. Address J. D. Hawkes, general manager, 12 Woodward avenue.

BOSTON, MASS.—The Newton & Boston Street Railway Company has secured a location for its tracks on the boulevard to the Boston line, but the road will not be built, so it is understood, until some definite arrangement is made looking to its connection with the reservoir line of the West End Company.

BRIDGEPORT, CONN.—The Bridgeport Traction Company wants to run its road west to Westport, through Fairfield and Southport; also to Parlor Rock, and a branch to Stratford, which will cross the town of Milford and from there proceed to Sanford's hotel in Woodmont, which is now the terminus of the West Shore road.

DETROIT, MICH.—Electrician Harris has completed his estimate on the expense of equipping with electricity the lines of the Detroit Citizens' & Street Railway Company, and the company has ordered its purchasing agent to buy materials for such equipment at once. Material will be bought in Detroit as far as possible.

STOCKTON, CAL.—The Ideal Placer, Mining, Water & Power Company will furnish water free of charge for one year for the purpose of generating power to be used in operating an electric railroad between here and Lodi, or between here and Sacramento, provided a railroad is built between Stockton and either of the points named.

FOND DU LAC, WIS.—The Fond Du Lac Railway Company's plant has been sold by the sheriff to satisfy liens. The roadbed and track of the electric railway has not been operated since last summer, and was bid in by Elihu Colman, for $322.53, and the plant, inclusive of all appliances and machinery, for $4,367.29. It originally cost $75,000.

LEWISTON, ME.—Notice has been served on the City of Lewiston that the Lewiston Bleachery and Dye Works will apply to the next Legislature for a charter to construct an electric railway from the Main Central station on Lower Main street to the company's works about a mile distant. The scheme will involve the expenditure of about $25,000.

WASHINGTON, D. C.—Senator Teller has introduced a bill to incorporate a company to build an elevated electric railroad between Washington and New York capable of developing a speed of 100 to 150 miles an hour. The bill provides that the road must run trains at the rate of 100 miles an hour, and must carry passengers for two cents a mile.

BINGHAMTON, N. Y.—The Binghamton & State Line Railroad Company, which has begun the construction of a road to connect this city with Williamsport, Pa., is finding great difficulty in securing its right of way along the proposed route. The projectors of the road are now considering the advisability of using electricity instead of steam as a motive power.

CORNING, N. Y.—At the Common Council meeting a franchise was granted to the Corning and Painted Post Company to build an electric railroad. Mayor Adams signed the franchise, which the company accepted. The capital is $100,000. This is the same company that obtained the franchise at Painted Post. Edward Shedd, of Worcester, Mass., is president of the company.

FREDERICK, MD.—Another effort will be made to build an electric railway between Frederick and Middletown. The route is 8 miles long, and crosses Catoctin Mountain. The Middletown Valley people have less than $4,000 of their share of the necessary fund to raise, and it is believed that this sum will shortly be obtained, in which event work on the road will begin next spring.

HINGHAM, MASS.—The Hingham selectmen voted unanimously to grant the franchise petitioned for by the Hingham Street Railway Company. The company is capitalized at $45,000 and will go to work on the construction of the railway as soon as the spring opens. The opening of this railway will form an important link between Nantasket Beach and Boston and interior towns.

BANGOR, ME.—The Bangor and Oldtown electric railway scheme is again being stirred up. The Lewiston Journal says that a representative of a New York syndicate has been in Oldtown and Orono, calling upon the stockholders in the company that have a charter for the building of a street railway from this city through Orono to Bangor. If the deal is made, work will begin 10 days later.

SOMERSET, MASS.—The Selectmen of Somerset gave a hearing in the new hall, on the petitions of the Taunton Street Railway Company and the Fall River & Taunton Company, for a location. John W. Cummings, of Fall River, and Attorney General Knowlton appeared for the Fall River & Taunton road, S. M. Thomas, of Taunton, and A. H. Hood, of Fall River, appearing for the Taunton road.

STOCKTON, CAL.—The directors of the electric street railway company are considering the advisability of establishing an electric plant of their own, to furnish power for propelling the street cars, instead of renting the power from the Gas, Light and Heat Company. If it is decided to establish the plant, it will be located on the lot adjacent to the company's car house, near the corner of California and Oak streets.

NORWICH, CONN.—A trolley road between Norwich and New London is one of the possibilities of the near future. The Norwich Street Railway Company own a charter for a trolley road between these points. The charter expires in July, 1895, unless something is done toward the building of the road. The company has already taken steps to protect its charter. For the past week or two surveyors have been at work between New London and Norwich.

ATLANTIC CITY, N. J.—At the regular meeting of the City Council application will be made for a right of way along South Carolina and Arctic avenues for the building and operation of a double track electric railroad. A largely signed petition favoring the project will also be presented. The promoters of the enterprise are Congressman John J. Gardner, ex-Postmaster Levi Albertson, and Law Judge Adams. There is no doubt but that they will receive the franchise.

LORAINE, O.—The right of way has been secured for a new railway. It will be run from the terminus of the Johnson electric road to Oak Point, a pleasure resort four miles from Loraine; from there to North Amherst, three miles; then to Loraine by way of the quarries, about five miles, to the place of beginning, making almost a circle. H. J. Reddington, president of the Amherst Bank, is at the head of the enterprise. The originators promise to have the road finished inside of a year.

TRENTON, N. J.—The New York and Philadelphia Traction Co., of which ex-Mayor Frank A. Magowan is the president, has in preparation an application for a franchise for the right to use certain streets in this city in connection with its proposed through line between this city and Elizabeth, Newark, Paterson and New York on the one side and Burlington and Camden and Bristol and Philadelphia on the other. The company has bought a large tract of land at Plainfield for the location of one of its principal power houses, which will be built at a cost of some $500,000.

BALTIMORE, MD.—Plans for an annex to the Traction Company's power house on South Charles street have been made by Henry Brauns, architect. The new building will measure 82x84 feet, and will be on Conway street, west of Charles. It will also have an addition 40 feet square, making the entire structure L-shaped. In the main annex will be an office, a wagon shed, storage room for machinery, stable and feed room. The addition will be used for an engine room and boiler house. The material chosen for the building is brick, with granite base and trimmings. A cement floor will be laid in the wagon shed. The roof will be of plastic slate.

NEW HAVEN, CONN.—The New York, New Haven & Hartford Company is contemplating placing electric cars on its Nantasket Beach and Warren & Bristol branches, and perhaps, to still further extend the system if the experiment comes up to expectations. A finely equipped power house is to be built just

west of the termination of the steamboat wharf at Nantasket Beach, on the land now occupied by the company for the storage of cars. The current for these lines will be supplied by power houses, one located at Warren, which will run the cars from Providence to Fall River, including Bristol branch, and another at Westport Factory, on the New Bedford line. It will be 35 miles in length. C H. Platt is general superintendent, New Haven, Conn.

PERSONAL NOTES.

MR. HENRY W. FRYE of the staff of THE ELECTRICAL WORLD has been compelled by ill health to abandon, for a time, his editorial work and will seek recuperation in the milder climate of New Mexico. The readers of the paper whom he has so faithfully served during the past three years will, we feel sure, join us in heartily wishing him a speedy recovery to health and a prompt return to the field of technical journalism, in which he has made such a marked success.

MR. FREDERICK E. DEGENHART, whose death occurred at Chicago on December 7, 1894, is the subject of a sympathetic memorial notice by the Standard Underground Cable Company, of which the deceased was the Western manager. A copy of the sheet will be sent to any of the numerous friends of its highly appreciated late employee upon application to the Pittsburg office.

MR. MAX OSTERBERG will deliver four lectures in the course of free lectures for the people, instituted by the Board of Education, New York. The subjects will be as follows: Lecture 1.—Fundamental Principles of Electricity and Magnetism. Lecture II.—Current Electricity and Electro-chemistry. Lecture III.—The Dynamo and Motor. Lecture IV.—Applications of the Motor and Dynamo.

Mr. FRANK P. LITTLE, whose death recently occurred at Buffalo, N. Y., was one of the most widely and favorably known electrical engineers of the East, and his loss will be deeply felt in an unusually extended circle of friends and acquaintances. Mr. Little was one of the first electrical engineers to enter into business extensively independent of the large electrical companies, and led the way to a practice which has now become so extensive. Among other important work done by Mr. Little was that connected with the lighting of the State Capitol at Albany, where he installed one of the earliest storage battery plants.

MISCELLANEOUS NOTES

THE MONTREAL ELECTRIC CLUB held its third annual meeting on January 7th. The election of officers took place with the following results: President, W. B. Shaw; Vice-president, H. O. Edwards; Sceretary-treasurer, Cecil Dantor; Committee of management, T. F. Pickett, J. A. Duglass and W. Graham.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its ninety-third meeting at 12 West Thirty-first street, New York City, on Wednesday, January 16, at 8 P. M. A paper will be presented by Professor Alexander Macfarlane, of Ithaca, N. Y., "On the Units of Light and Radiation." A paper will also be presented by Mr. Alton D. Adams, of Boston, entitled, "The Best Metal for Field Magnet Frames." A meeting of Western members will be held the same evening, Wednesday, January 16, 8 P. M., at Armour Institute, Thirty-third street and Armour avenue, Chicago, where, in addition to the above papers, Professor Stine will present an illustrated historical sketch of the first three-wire Edison plant at Sunbury, Pa. If time permits this matter will also be taken up at the New York meeting. To comply with the rules governing the election of officers, the January issue of the Transactions will be held until the first week in February, in order that it may include a complete list of members revised up to that date. Changes of address, if sent in at once, will be in time to appear correctly in this list.

THE BUFFALO ELECTRICAL SOCIETY has secured the services of Prof. Albert L. Arey for a course of ten lectures on "Practical Electrical Engineering," to be given at the rooms of the society, in the Library Building, commencing January 19, 1895, and continuing every alternate Saturday evening, until the course is completed. Prof. Arey is a member of the New York University Extension Course, Professor of Physics in the Rochester Free Academy, and is eminently qualified to place before an audience complicated problems in the most elementary manner. The course of lectures will be of a practical nature, particularly suited to those who have a knowledge of the rudimentary principles of electricity, and is as follows: 1. "How to Produce Electrical Pressure;" 2. "The Electric Circuit and the Effects of the Current;" 3. "The Electro Magnet and its Applications;" 4. "Theory of the Dynamo;" 5. "Elements of Dynamo Design;" 6. "Faults and Ailments of Dynamos, and How to Detect and Remedy Them;" 7. "Alternators and Apparatus for Alternating Circuits;" 8. "Motors and the Transmission of Power;" 9. "Installation Equipments and Methods of Distribution;" 10. "Storage Batteries and Chemical Work." Prof. Arey will illustrate his lectures with a very complete outfit of experimental apparatus. Mr. Frank C. Perkins is president of the society and Mr. A. C. Terry secretary.

THE NATIONAL CONVENTION OF MANUFACTURERS.—The assembly to be held in Cincinnati on January 22, 1895, will be a convention fairly representative of the manufacturing interests of the United States, and will have for its object, in the first instance, to consider and reach conclusions on the main question; *i. e.*, that of forming a National Association of Manufacturers. The main questions to be considered are: First, expediency; second, feasibility, and third, method. After the vote is taken upon the preliminary questions, "Should such an association be formed?" and "Can such an association be formed?" it will be necessary to devote most careful deliberation to the questions "How?" and "To what end?" The preliminary inquiries issued by the Manufacturers Association, and reiterated by the Committee of Arrangements and Invitation in their very handsome and elaborate invitation and circular, are intended, in a purely tentative way to secure in advance of the meeting some general index of prevailing sentiment among manufacturers generally, upon the main question. To this main question, "Do you favor the organization of a National Association of Manufacturers?" replies thus far received are almost unanimously affirmative. Upon the second tentative inquiry, "Will you be present or represented?" the affirmative vote is so largely in the majority as to promise a representative gathering. Answers to the third inquiry, which calls for names of those who will come, display a roster which affords assurance that whatever action is taken by the Convention will be wise and deliberate.

Trade and Industrial Notes.

A CORRECTION.—In the advertisement of the Geo. L. Colgate Co., 136 Liberty St., in our last issue the offer of 22 cp lamps at 25 cents should have read 32 cp lamps.

THE ANSONIA ELECTRIC COMPANY, by permission of the Court to Receiver Cha. S. Merrick, will be sold. Bids will be received sealed, and to be opened the first Monday in February.

THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth Ave., Chicago, has recently been making some changes in its store and has put in some new counters and shelving, thus adding to its attractiveness and furnishing better facilities for the display of its increased line of goods.

MR. FRANK STEWART, dealer in electrical supplies, Philadelphia, has moved from 41 to 20 North Seventh street, where he will carry on a general electrical supply business on a more extensive scale; having now a large place and better facilities he is enabled to carry a full line of all supplies.

THE PHOENIX CARBON MFG. CO, 2,134 De Kalb St., St. Louis, reports that it is now fully equippped and its works are running at their full capacity. Its orders are coming in satisfactorily, and the company guarantees satisfaction and prompt attention to all its customers. This company is outside of the carbon trust.

HENRY R. WORTHINGTON has installed an hydraulic plant at the National Carbon Company's Works, in Cleveland, consisting of two compound pressure pumps and two steam accumulators. The pressure carried is 4,850 pounds per square inch and the action of the steam accumulators under this pressure is remarkably smooth and easy and in marked contrast to the varying pressure of a weighted accumulator.

THE GARLOCK PACKING COMPANY, of Palmyra, N. Y., has recently established a New England branch, with offices and salesrooms at 12 Pearl street, Boston, Mass. Mr. John D. Lane, for many years special traveling salesman of the company, has been appointed general manager of the New England branch.

THE ACTON VALVE AND STEAM SPECIALTY COMPANY, No. 79 Washington street, Brooklyn, has just issued a catalogue of its steam and water specialties. Among other specialties illustrated and described is the Acton Regulating Valve, which has been entering so largely into use in connection with electrical plants.

THE ELECTRIC APPLIANCE COMPANY, Chicago, claims to have something entirely original in an advertising novelty which is something that every electric light man in the country has been in need of ever since he went into business, but an article which the market has failed to supply. The "cat will be let out of the bag" at the Convention of the Northwestern Electrical Association, at Milwaukee, on the 16th.

MR. JOHN S. PUGH, Eastern representative of the Darner & Dutton Company, manufacturers of street car trucks, Cleveland, Ohio, reports having done an excellent business during his last trip through the States of New York and Pennsylvania. The company has also booked an order from the Cleveland Street Railway Company for seventy-five trucks, and one for seventy trucks from the Detroit, Mich., Street Railway Company.

THE WASHINGTON CARBON COMPANY, of Pittsburg, Pa., has recently booked some large orders for its new cored carbons. The testimonials received from users of these carbons are exceedingly flattering, and the inquiries which are being continually received are indicative of a big business for 1895. This company has issued a very neat little blotter with celluloid facing upon which appears a scale for measuring carbons, showing the relation of millimetres to inches.

MR. D. M. STEWARD, of the D. M. Steward Mfg. Company, makers of lava insulators, Chattanooga, Tenn., at a recent meeting of the Chattanooga Chamber of Commerce, delivered one of the leading addresses, responding to the toast of "Our Manufacturing Interests." In the course of his address he referred in highly complimentary words to the influence of the press. Newspapers, he said, are in a sense also manufacturers, as expert mechanical knowledge is indispensable to a paper's successful production of a paper of correct proportions, clear legible printing and a pleasing makeup.

THE FOSTER ENGINEERING COMPANY, of Newark, N. J., reports a rapidly increasing demand for its new "Class W" steam pressure regulators. Among orders just booked for large valves it mentions one 10-in. for the Lehigh Valley R.R. Co.'s coal mines; three 8-in. and one 5-in. for the Watts-Campbell M'f'g. Co., for use at the Newark Electric Light and Power station; one 6-in. for the U Street Pumping Station, Washington, D. C.; one 5-in. for Dixon's Paper Mills, and two 6-in and two 4-in. for the new American Liner "St. Louis." These latter are in addition to twenty regulators from 8-in. to 4-in. furnished for that ship in December.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is building the new car barn for the Lehigh Traction Company at Hazelton, Pa. The same company has a contract for the new Power House for the Keene Gas Co., at Keene, N. H. The new power station for the United Electric light & Power Co., on West 28th Street, New York, is now being put in place by the same company. This will be a model station and one of the most complete and perfect in the Eastern States. The engine and dynamo room is 100 feet square, and the boiler room 60x100 ft. The roof covering on the dynamo room is to be of anti-condensation corrugated iron. The coal pockets in the boiler room will have a storage capacity of 3,000 tons of coal.

Business Notices.

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

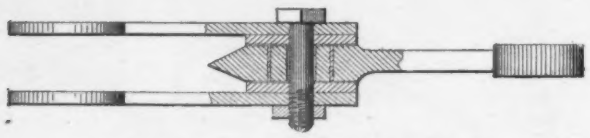
UNITED STATES PATENTS ISSUED JANUARY 8, 1895.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

532,031. SELF ADJUSTING TROLLEY; J. Corcoran, Harrisburg, Pa. Application filed August 29, 1894. This comprises two shells having recesses to receive the standard, a standard with stops thereon, and a pin on one of the shells between the stops.

532,095. ELECTRIC ARC LAMP; A. W. Richardson, Patricroft, England. Application filed March 2, 1894. The combination with a hollow tube, through which the carbon passes, of a tube provided with a shoulder, runners, prongs or fingers, and a clutch box.

532,101. INSULATOR FOR ELECTRIC WIRES; D. M. Rothenberger, Lancaster, Pa. Application filed April 4, 1894. In an insulator, a cap covering the connection between the insulator and the wire.



No. 532,168.—Trolley Wire Clamp.

532,103. ELECTRIC LAMP SUPPORT; F. Schefold and J. Northney, New Albany, Ind. Application filed March 1, 1894. This comprises a support and pivoted counter weight, of a tapered guide, and a lug upon the hook adapted to actuate the guide.

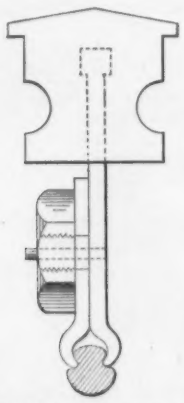
532,104. CONDUCTOR SUPPORTER; J. C. Love, Chicago, Ill. Application filed May 9, 1894. This comprises two clamping plates, one apertured and the other having a loop projecting through the apertured plate, and a wedge key driven through the loop, and engaging the outer face of the apertured plate to force the plates towards each other.

532,113. CONVERTER SYSTEM FOR ELECTRIC RAILWAYS; G. W. Swartz, Florence, Ala. Application filed October 12, 1893. This comprises a switch having an electro-magnet traversed by the secondary circuit when closed and the armature of which constitutes the movable switch member, whereby the secondary coil and coil of the switch magnet are in series.

532,126. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; A. G. Wheeler, Chicago, Ill. Application filed January 21, 1893. This comprises two sectional supply conductors, one for each track of a two track railway, the ends of the sections of one conductor being connected with the ends of the adjacent sections of the other conductor to maintain an equilibrium of the supply current to the motors connected with the two sectional conductors.

532,133. TROLLEY WIRE CLIP; J. M. Anderson, Boston, Mass. Application filed July 9, 1894. This comprises an "ear," and clip secured thereto, an arm secured to the ear, and means to engage the arm with the trolley wire.

532,142. AUTOMATIC SAFETY ATTACHMENT FOR GAS BURNERS; H. H. Cummings, Malden, Mass. Application filed January 19, 1894. This comprises a gas burner and its cock, a retarded electric circuit closer made operative by the opening of the cock, and a heat actuated device, whereby the operation of the circuit closer is nullified when the gas is burning.



No. 532,160.—Insulator.

532,157. UNDERGROUND TROLLEY ARM; P. C. Just, Chicago, Ill. Application filed January 4, 1894. This comprises a conductor and a flat supporting bar, having recesses at its side edges, and blocks inserted in the recesses, and adapted for contact with the sides of the conduit-slot.

532,160. INSULATOR; M. D. Law, Washington, D. C. Application filed August 29, 1893. This comprises a central link provided at one end with a chamber, side links, a coupling bolt, and insulating material within the chamber of the central link, and provided centrally with an aperture of greater diameter than the coupling bolt. (See illustration.)

532,161. CONDUCTOR; M. D. Law, Washington, D. C. Application filed September 22, 1894. This comprises a conduit, a conductor, supports for same, and blocks of insulating material secured to the conductor between the supports to prevent contact of the same with the wall of the conduit.

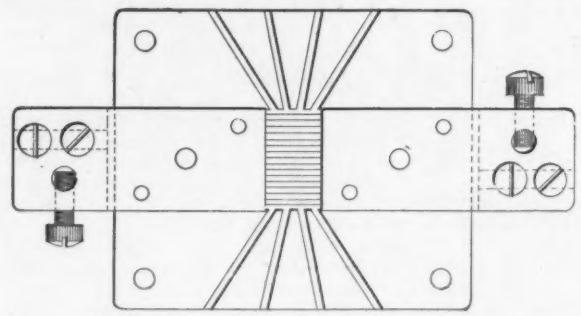
532,165. CONDUIT FOR ELECTRIC RAILWAYS; J. C. Love, Chicago, Ill. Application filed May 9, 1894. This comprises yokes, and a supplementary conduit pipe, comprising integral tubular sections on the yokes, and longitudinally divided pipe sections engaging the sleeves.

532,166. TENSION DEVICE FOR ELECTRIC CONDUCTORS; J. C. Love, Chicago, Ill. Application filed May 9, 1894. A telescoping connection between the sections of an electric conductor, comprising an insulating plate, sleeves attached thereto to receive the ends of the conductor sections, and a revoluble disc mounted on the insulating plate with its periphery engaging the inner ends of the sleeves, the disc being provided with conducting and non-conducting parts.

532,167. ELECTRIC RAILWAY TROLLEY; J. C. Love, Chicago, Ill. Application filed May 9, 1894. An arm comprising a short and a long section, the long section carrying the contact device, and pivoted to the short section, an arm rigidly secured to the short section, and a spring attached to the latter arm for lifting the contact device.

532,168. TROLLEY WIRE CLAMP; J. C. Love, Chicago, Ill. Application filed July 11, 1892. This consists of two flat plates having flanges to engage grooves in the wire, and a screw threaded stud arranged to secure the plates together. (See illustration.)

532,185. CONDUCTOR BOND FOR MEETING ENDS OF RAILS OF ELECTRIC RAILWAYS; R. Reith, Chicago, Ill. Application filed June 14, 1894. A given length of conducting material, a plurality of perforated contact



No. 532,353.—Lightning Arrester.

studs projecting therefrom, thimbles within the studs, perforations in the meeting ends of the rails, and means for upsetting the metal of the studs within the perforations of the rail.

532,195. TROLLEY SUPPORT; L. T. Gibbs, Milwaukee, Wis. Application filed July 28, 1893. This comprises a stand on the car provided at its front and rear only with transverse bearing surfaces, a base adapted to receive the pole, and formed at its ends to be sustained by the bearing surfaces, and to rock thereon back and forth and laterally, and means tending to hold the base yieldingly in an upright position.

532,200. TROLLEYS OR ELECTRIC RAILWAYS; J. C. Henry, Westfield, N. J. Application filed September 27, 1889. This comprises a flat ribbon overhead conductor, a contact trolley pendent therefrom, wear plates running on top of the conductors, and lubricators carried by the wear plates.

532,261. CONDUIT ELECTRIC RAILWAY; A. M. Burgher, Clay City, Kentucky. Application filed April 17, 1894. This comprises a trolley arm, a vertically movable spring cushioned hub thereon, and a trolley wheel journaled on the hub.

532,302. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; F. Windle, Philadelphia, Pa. Application filed March 8, 1894. This comprises spring plates extending beneath the slot of the conduit, and a trolley for depressing the plates.

532,328. INSULATED PIPE JOINT; M. J. Locke, Philadelphia, Pa. Application filed June 6, 1894. This comprises blocks adapted to receive the pipes, insulating material between the blocks and straps for confining the blocks together and to the insulating material.

532,353. LIGHTNING ARRESTER; A. Wurts, Philadelphia, Pa. Application filed February 28, 1894. This comprises a pair of insulating plates, a pair of sparkling terminals and an interposed discharge wedge, one or both of the blocks having a plurality of grooves extending outward laterally from the wedge. (See illustration.)

532,354. LIGHTNING ARRESTER; A. J. Wurts, Philadelphia, Pa. Application filed August 3, 1894. This comprises a pair of sparkling terminals, and an interposed discharge wedge formed in a body of fibrous material, the fibers of which extend in a direction transverse to the static discharge.

532,391. ELECTRIC LAMP SUPPORT; J. Northey, New Albany, Ind. and F. Schefold, Parkersburg, West Va. Application filed October 18, 1892. The combination with a lamp, of hooks pivotally secured thereto and locking mechanism for temporarily holding the hook in a fixed position.